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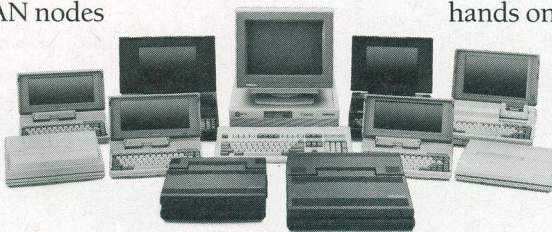
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Canada's Magazine for High-tech Discovery

Volume 13, Number 4

April 1989



Our Cover

The Philips series of digital storage scopes is courtesy of Fluke Electronics; the GP-CD60 camera photo is courtesy of Panasonic.

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Blush

The second part of our Class One audio
amplifier project has been held up due to
problems with the large, one-piece PC
board. We apologize to any readers inconvenienced by this, and promise to have it
complete by next month.

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Circle No. 4 on Reader Service Card

Blush/#2...

In our December issue we omitted the PCBs for the Peak Program Meter project. The smaller board and the larger one appear on page 12.

Continued on page 12

E&TT April 1989



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Panasonic GP-CD Industrial Cameras

MOS sensors meet microchips to make a new generation of smart cameras.

BILL MARKWICK



If you think that industrial cameras are limited to those little black boxes watching the shoplifters in department stores (or installed in factories to watch the employees and irritate the labour unions), here's a look at the GP-CD series of cameras from Matsushita's Panasonic Industrial Video division. No longer do cameras merely send out a video picture for someone to watch on a monitor; they're really one part of an image processing system that approaches the goal of machine vision.

The Basics

The camera on our cover, the GP-CD60, has a single MOS chip as the image sensor, providing an image area of $2/3"$ that's divided into 649 by 491 pixels. The output signal, which is either composite video or horizontal and vertical drives, can feed directly into monitors or processors, or into the optional GP-RC20 remote control box. This latter unit allows a number of special scanning functions, including single and double-speed sequential scanning (as well as the usual interlaced mode)

for applications where high-speed processing of an object is required. The horizontal resolution of 450 lines exceeds the quality of commercial television broadcasts.

Processing of a moving object becomes rather difficult when the image is a blur, so in conjunction with the RC20, the electronics of the camera provide an ingenious solid-state simulation of a focal-plane shutter. Photography fans will know that the fastest shutters are those which move a slit curtain across the plane of the film; the narrower the slit, the shorter the exposure time — this method allows speeds of up to $1/4000$ of a second on consumer equipment. To implement this without moving parts, the RC20 scans the camera's MOS sensor a few horizontal lines at a time. The fewer the lines in the electronic "window", the shorter the exposure, from $1/60$ to $1/16,000$ of a second.

Exposure control, which you would expect to be accomplished by a motor-driven iris, is done electronically by the solid-state shutter in the camera head,

providing a range from 0.5 footcandles (5 lux) to the brightest possible light. According to our studio light meter, a value of 0.5 footcandles indicates just enough light to read by if you strain at it, something like candlelight.

Remote Control

The GP-RC20 is equipped with an RS232 port to allow external control. This port can receive commands from industrial control equipment, or a computer, and can select one of the four scanning modes, apply scanning synchronization, etc. One of its special functions in high-speed processing is to narrow down the area of view to the minimum required, reducing the scanning time; it's a sort of electronic zoom (if you're not using the remote control unit, the camera head itself has four preset window areas for reduced scanning).

With an external signal sync generator and a remote sensor (purchased separately), the scanning of the GP-CD60 can be reset asynchronously. The purpose

of this is to start the scan at the proper time to make a moving object appear in the centre of the screen, a feature useful for monitoring objects moving on a conveyor or through machinery. This is a sort of electronic pan control, within the limits of the field of view.

Other Features

The tiny camera, at 1.75" square by 4.6" long, weighs only .73 pounds. If the remote control unit is not being used, it can be powered by a 12V DC, 250mA supply. Various lenses can be fitted to the C-mount, and a tripod mounting bracket as well as various cables are available.

Other Cameras

Other units in the Panasonic line include the GP-CD40, a general-purpose model with a resolution of 380 lines and a fixed shutter speed of 1/1000 of a second; its sensitivity of 2 lux makes it ideal for low-light uses.

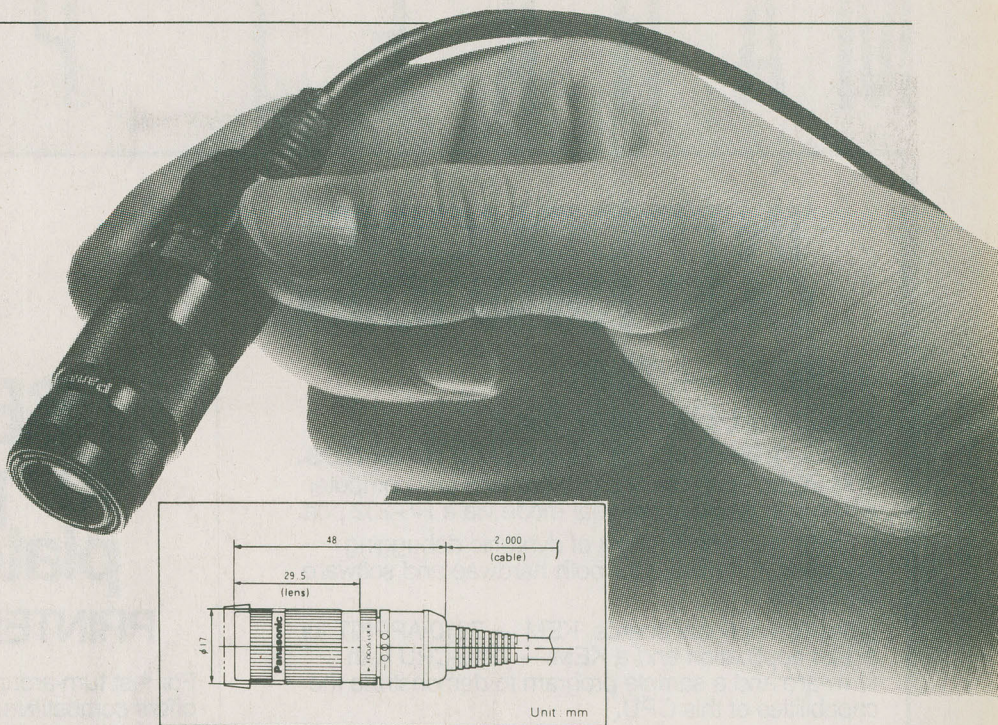
The GP-CD110A Color Camera is another general-purpose camera for use where remote control and fast shutter speed is not required. Its resolution is 280 lines.

The GP-CD55 is in the middle of the B&W range; it features 380 lines of resolution and selectable interlace/non-interlace scanning modes for industrial applications.

An interesting model is the tiny GP-CD1 Color Micro-Camera, less than one inch in diameter and less than two inches long, and capable of functioning up to 10m from its small control unit. Despite its size, the sensor provides 250,000 pixels and a horizontal resolution of 330 lines. With its optional wide-angle or pinhole lenses (plus a fibre scope and bore scope), applications include internal inspection of machinery, a visual sensor for robots, etc., microscope use, medical inspections, and various other scientific uses where a larger camera might intrude. Two or more cameras can be integrated for multi-camera setups.

If you think of video cameras as bulky units that produce glaring, streaky images, check out the latest types and see what the new solid-state sensors and control circuitry can do. Lack of bright-light burn, no tubes, computer control, high resolution and tiny size — there's not much more you could ask for.

For further information, contact the Panasonic Industrial Division of Matsushita Electric of Canada, Ltd., 5770 Ambler Drive, Mississauga, Ontario L4W 2T3, (416) 624-5010. ■



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PC Hardware Interfacing

Part 4

Deeper and deeper into the mystery of port addresses.

STEVE RIMMER

In the first two installments of this series, we looked at how to decode the PC's address bus and access specific ranges of hardware ports. We're going to get into this area a bit more this month and actually talk about getting useful data out of the PC.

There are those who will hold that this is a largely quixotic task, and that nothing useful has ever come out of a PC, or ever will. There are days when I'd be wont to agree with this.

One of the most interesting things you can do with a PC when you're first getting into designing hardware for one is to get it to make something happen external to itself, preferably something other than what it could normally do with its existing peripherals. Having it drive a printer, for

example, is not very impressive — it's been done. Getting it to turn on all the lights in your house is a bit better. Having it locate and summarily vapourize all the cats in a 20-block radius of your digs is getting up there. When we get done learning how to interface to a PC, perhaps we could do a laser death ray project.

This month we'll press on ever closer to getting useful information out of the PC.

Toad in the Hole

In our previous look at the circuitry of PC interfacing, we saw how to recognize when the processor wanted to talk to a port, and how to narrow down the port in question to a range of 32 consecutive ports. In the example we looked at, our hardware decoded ports in the range of 300H

through 31FH. We'll stick with this range here, although, as you'll recall from the second installment, the base port range can be switch selectable, as it usually is on commercial cards.

Having decoded the port address down to something manageable, it would be exceedingly handy to be able to tell if a single port in that range is being addressed. This will be our first task for this month.

Given that the processor is talking to a port in the range of 300H to 31FH, the number of the port within that range can be expressed in five bits. In fact, it is. It's the binary number that lives in the lowest five address lines. As such, if we were to take the data on these lines as a number at the time that our board is being addressed and add it

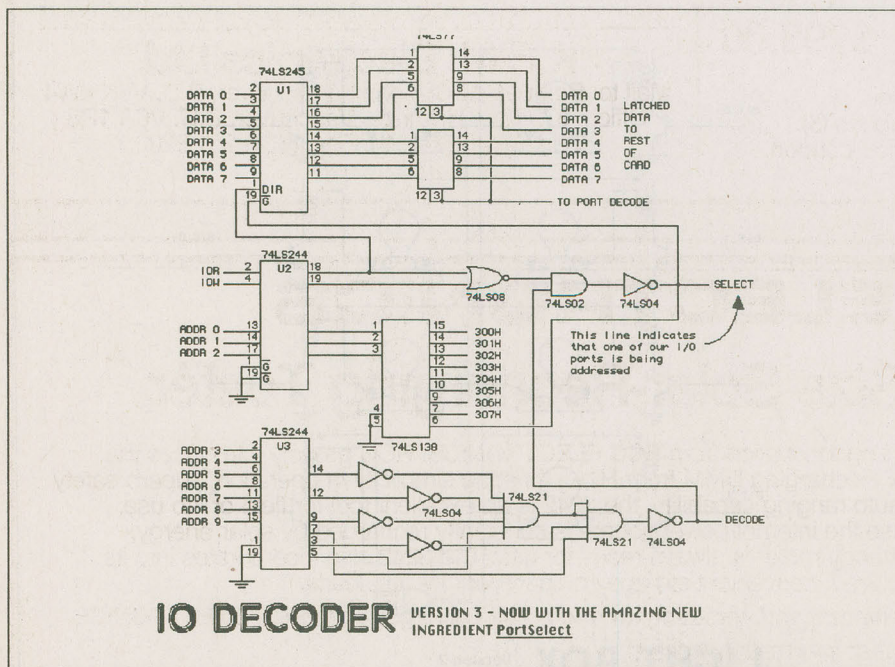


Figure one. This is the latest version of the peripheral card. It features single port decoding and a data latch. The eight numbered outputs of the 74LS138 represent port select lines. One of these, corresponding to the port we want to read from, should be connected to the combined latch lines of the 74LS77's at the top of the diagram.

E&T April 1989

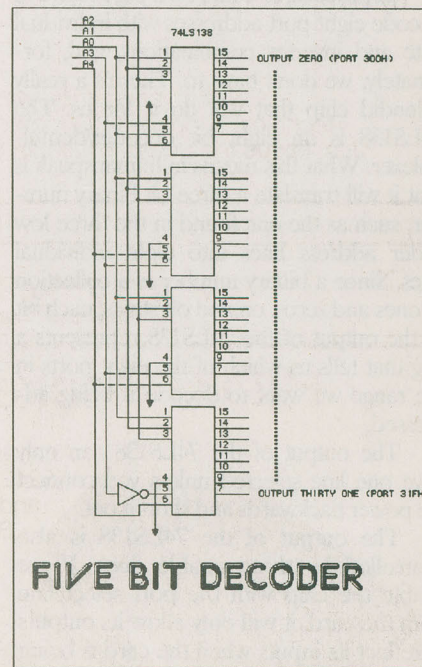


Fig. 2. This is a five bit decoder using four 74LS138's. It allows you to select among thirty two ports... assuming you can find a use for 32 unique ports on your card

PC Hardware Interfacing, Part 4

and add it to the base port address of 300H, we would know the actual port within the range that the processor is trying to talk to.

For the purposes of this discussion, and to keep the circuit diagram accompanying this feature down to a manageable hugeness, we're going to assume that just about any sensible card can get its act together with eight or fewer ports. As such, we're actually only going to decode the first *three* lines. However, as will be obvious once we get into this, you can work in the fourth and fifth ones if you need the whole range of 32 ports.

Let's start with a simple example. Assuming that we want to decode port 300H, we would want all three of our lines to be low. This is dead easy. Simply connect three inputs of a quad input NAND gate across the three lowest address lines. When the card is selected and the output of the gate goes high, the processor is speaking to port 300H. This is the simplest decoding possible.

Since we're ignoring the fourth and fifth address lines, in theory the processor could be speaking to either port 300H or to the "phantom" ports 308H, 310H, 318H or 31FH and have this decoding turn up valid. It would be the responsibility of the software driving our card not to attempt to write to ports we haven't planned on decoding.

In practice, it would be a pig to have to decode eight port addresses with individual gate and inverter combinations, and, fortunately, we don't have to. There's a really splendid chip that will do it for us. The 74LS138 is an eight bit decoder/demultiplexer. What this means in humanspeak is that it will translate a three bit binary number, such as the one found in the three low order address lines into eight individual lines. Since a binary number is a collection of ones and zeros, on and off states, each bit of the output of the 74LS138 represents a flag that tells us which of the eight ports in the range we want to decode is being addressed.

The output of the 74LS138 can only have one line selected unless you connect the power backwards and short it out.

The output of the 74LS138 is also controlled by three enable lines. If we enable the chip with the port select line from the card, it will only allow its outputs to reflect its inputs when the card is being spoken to, that is, when the processor is attempting to read from or write to a port in the range of 300H to 31FH.

Assuming that we wanted something to happen when the processor wrote to

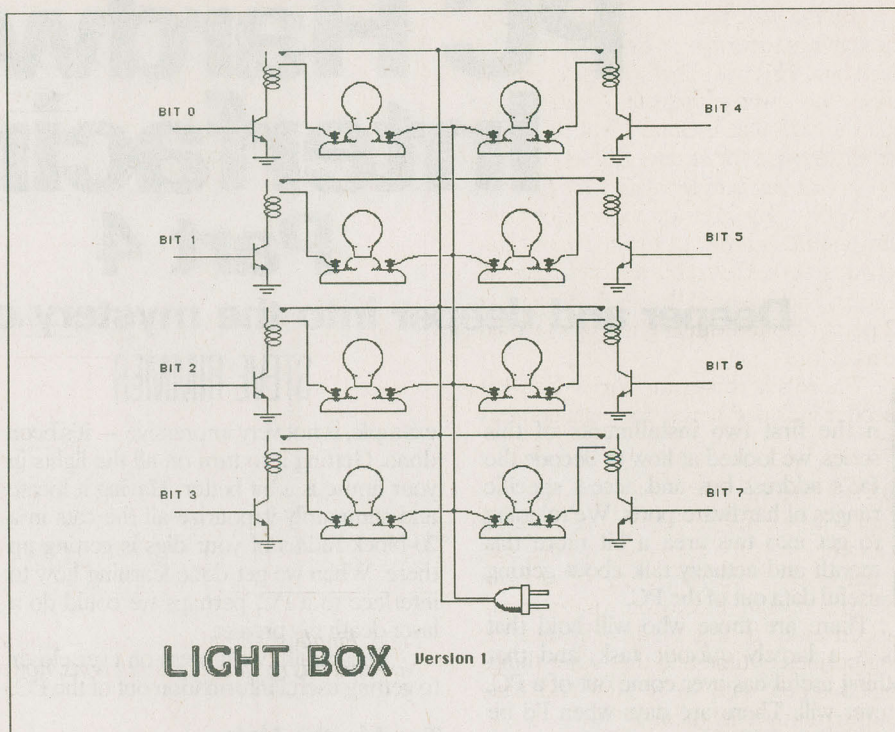


Fig. 3. A simple peripheral, this device will light up eight light bulbs based on the binary number at its input. This is not a complete schematic — don't try to build it.

port 302H, for example, we would wait for the card to be selected, as determined by the circuitry we looked at in previous months, and then wait for the third output

line of the 74LS138, pin thirteen, to go low. Actually, as the chip is enabled by the card select logic, we can cheat and just watch the output of the 74LS138 all by itself.

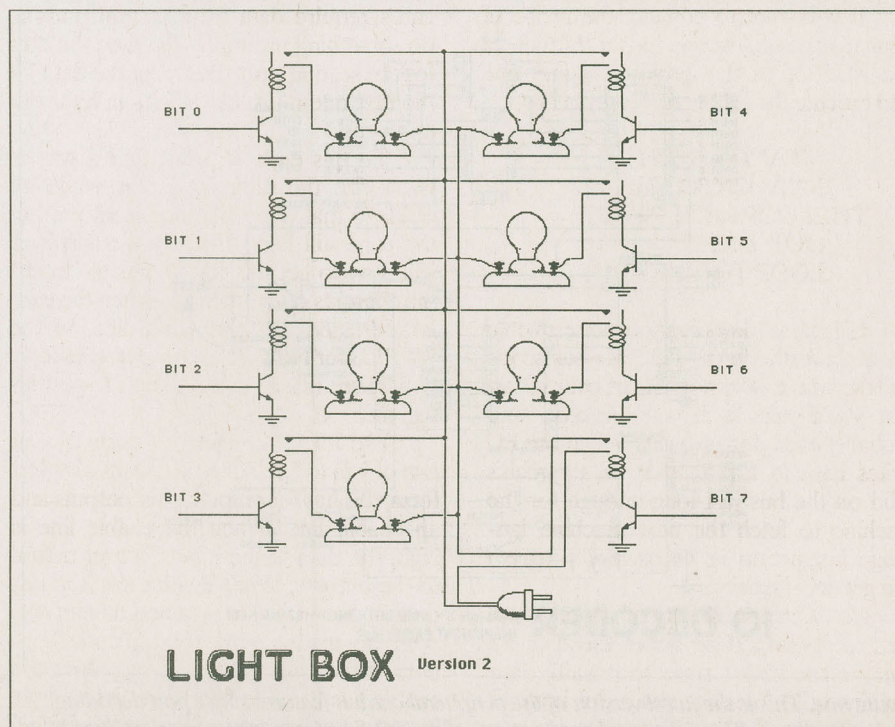


Fig. 4. The modified light bulb box with seven bulbs and a valid data flag. None of the bulbs will come on unless the high order bit of the port is set.

By the way, you can actually cascade these things to form a 32-bit decoder if you need one. This will allow you to decode all five of the lower address lines and let you build a card that uses all 32 of the ports we've decoded for at once. Short of some sort of extreme burglar alarm, the furnace controller of the gods or a laboratory system to monitor the systematic investigation of several thousand mouse mazes all at once, I have a hard time imagining what 32 ports (256 individual data lines) would be used for.

There's a diagram for a five bit decoder included herein for your pondering.

Lifting the Latch

Until now, we've been designing our card in a rather sterile, extremely forgiving, sort of universe. In this universe, we've been able to assume that computer phenomena happen more or less predictably, last for long periods of time and that other things don't happen until we're well and truly ready to let them.

Very little of this is actually the case. About the only part of it that is true is that we exist in a universe, and some of the more existential philosophers about the planet would certainly question even that. The important point herein, however, is that the universe, if it does exist, is a very nasty place for computers.

If you were to connect the probe of your trusty oscilloscope to pin thirteen of the 74LS138 in the circuit in figure one and execute the following program...

```
MOV DX,0302H
MOV CX,00FFH
THELOOP MOV AL,CL
OUT DX,AL
LOOP THELOOP
```

256 extraordinarily short pulses would grace the cathode ray tube of your scope and the whole works would be over so fast that you'd miss it if you blinked... and probably even if you didn't. When the PC writes data to a port, that data remains valid on the bus just long enough for the machine to fetch the next machine language instruction in its current program and get on with things.

It's the responsibility of a peripheral card to do something about the data it's sent in the short time that said data remains valid. In some cases this involves using the data for its ultimate purpose in that interval, but it's more often the case that the data has to be stored somewhere.

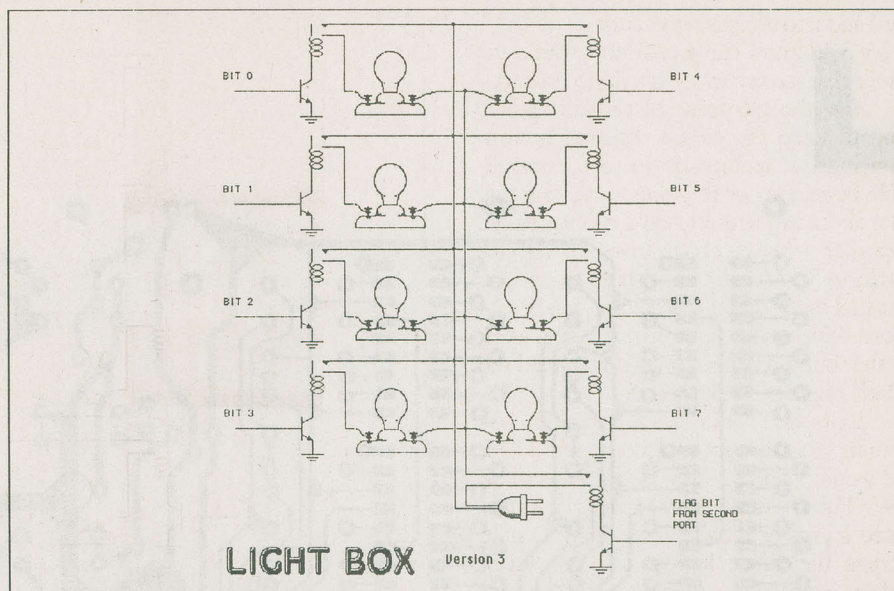


Fig. 5. Finally, civilization is saved — a light bulb box with eight bulbs and a valid data flag. Note that this requires two input ports, however.

In the case of a simple interface card, such as a printer port, it's dangerous to assume that the peripheral device that's being interfaced to is fast enough to catch a fleeting byte of data in the short time that it exists at a PC's port. In fact, it's ridiculous... printers aren't anywhere near that quick.

More to the point, most complex cards require data from several ports to do something useful. By the time the data for the second port shows up, the data for the first one must, by definition, have disappeared.

To this end, we must find a way to memorize the data at a port while it's valid, so that once it's gone from the bus the card still knows what has transpired. The way to get this together is to "latch" the contents of the data bus when the card is addressed and the select line on the 74LS138 for the port in question goes low.

There are, of course, chips to get this together too.

The 74LS77 is a four bit latch; it takes two of 'em to latch one byte. In its simplest form, this has four inputs, four outputs and an enable line. When the enable line is high, the data at the inputs is transmitted to the outputs. When it goes low, the last data at the inputs is retained at the outputs, no matter what subsequently happens at the inputs. As such, by pulling the enable line low, the latch turns into a four bit memory chip for as long as the enable line stays low.

You'll note that the outputs of the

74LS138 go low when their corresponding binary number appears at its inputs. This fits together very nicely. If we connect one of the eight outputs of the 74LS138 to the enable lines of our latches, the data at the output of the latch will always reflect the last data sent to the appropriate port.

Port Strategy

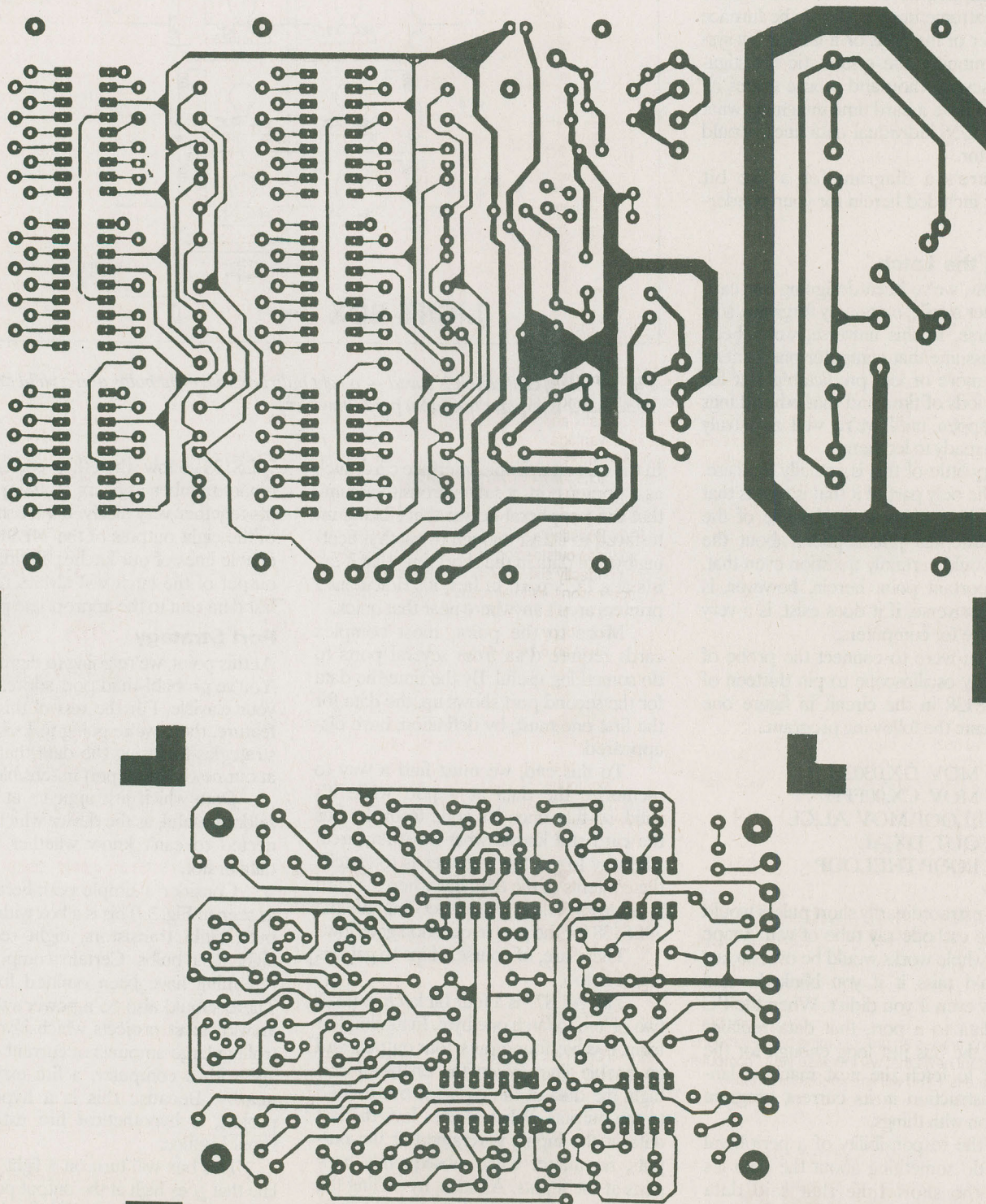
At this point, we're going to digress a little. You've probably had port addresses up to your clavicle. For the rest of this month's feature, then, we're going to look at some strategies for using the data that appears at our newly found port in sensible ways.

Data which just appears at a port is seldom useful, as the device which it's connected to can't know whether it's good data or not.

Consider a simple peripheral device, as seen in Fig. 3. This is a box with eight inputs, eight transistors, eight relays and eight light bulbs. Certain components of this thing have been omitted for clarity. There should also be a power switch and, as with most projects which involve controlling large amounts of current and voltage with a computer, a fire extinguisher nearby. Because this is a hypothetical project, a hypothetical fire extinguisher should suffice.

This box will turn on a light for every line that goes high at the output port of our little board. When our PC first boots up, some lights will probably come on because there is garbage data in the latch. Writing

Continued on page 37



The large and small printed circuit boards for December's Peak Program Meter.

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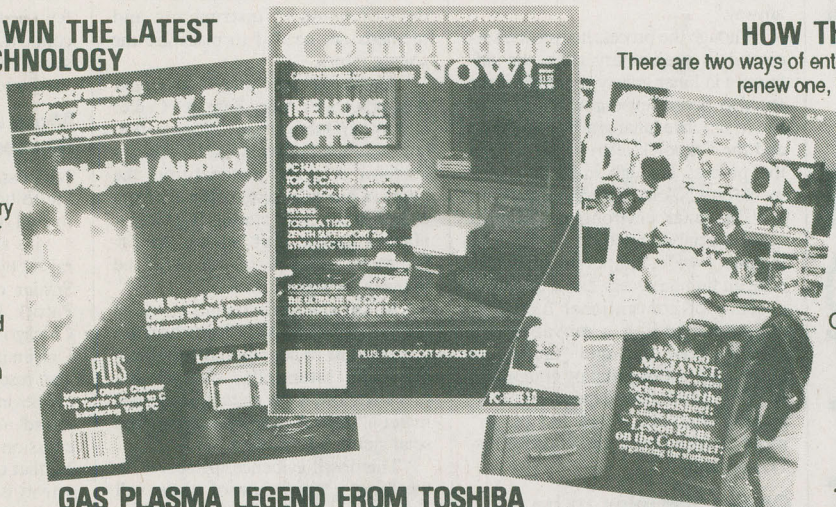
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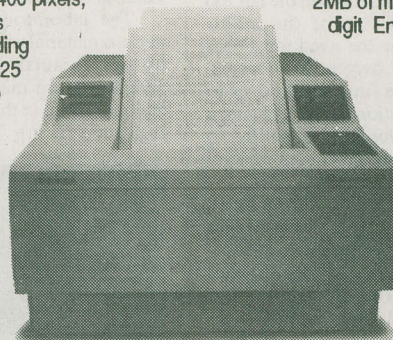
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THE SCIENTISTS TELL ME

DAVID P. DEMPSTER

Collecting Oxygen From Moon Mineral

When man establishes a space station on the moon, and he will in the not too distant future, one of the major problems will be the need for a constant supply of oxygen. In Houston, Texas, there is a firm which hopes to provide the solution to the problem, a most unique solution — a method to extract oxygen from the lunar mineral ilmenite.

Recently, Dr. Michael A. Gibson, president of the company, described his firm's technology to the Annual Meeting of the American Institute of Chemical Engineers. The process, which is being developed under a NASA research contract, is targeting to permit a space station on the moon to operate with fewer resupply launchings, because oxygen is projected to be one of the largest-volume consumable items.

Gibson's firm began developing the process in 1984. After evaluating several alternatives, a system which uses hydrogen to generate water and recoverable metals from ilmenite was selected. The oxygen is obtained by breaking the generated water into its components — oxygen and hydrogen.

The oxygen could be liquefied and stored, Gibson said, while the hydrogen would be recycled to start the process over again. The ilmenite needed for the reaction could be mined from the lunar surface. The mining would use about 10 acres per year to generate 1,000 metric tons of oxygen, "a small mining rate by earth standards," Gibson stated.

Engineers at Carbotek designed the hydrogen-ilmenite method to minimize the need for transporting the com-

ponents from earth. However, it may be necessary to import supplies of hydrogen to make up for some losses in the process, but, Gibson pointed out, "hydrogen will probably have to be brought from earth for propulsion anyway."

Though the process has proved successful in preliminary tests, the difference in lunar gravity could affect the reaction. Several experiments have been run to simulate lunar gravity conditions, and the Carbotek team will soon take the process through in-flight experiments on a NASA research aircraft.

The lunar environment imposes other special demand on the process, including wide temperature swings, difficult human access, and a complete absence of conventional fuels and coolants. Adding a movable sun shade, special seals and "the use of automated, robotic mining equipment to minimize human exposure at substantial distances from the plant," could help address these problems, Gibson said.

Comet Samples to be Studied in Earth Labs

From NASA comes word that a major study of comet samples is about to get underway. A group of international scientists met early this year in Milpitas, California to attend a workshop entitled "Analysis of Returned Comet Nucleus Samples", co-hosted by NASA and the Lunar and Planetary Institute.

The laboratory study of comet nucleus material will be made possible by the Rosetta-Comet Nucleus Sample Return mission, one of four major missions in the European Space Agency's Long Term Program

"Horizon 2000".

The interdisciplinary workshop brought chemists, geochemists, and physicists together with astrophysicists and astronomers to determine how best to study the pristine material and what developments in instruments and methods are needed to maximize the science return.

Studies of meteorites and cosmic dust at NASA's Ames Research Center and other laboratories suggest that comet samples will contain star dust, interstellar dust, and material from the origin of our solar system. Results from recent spacecraft studies of Comet Halley's gas and dust indicate that organic and inorganic material will be found in a cometary nucleus.

Scientists liken comet nucleus material to the Rosetta Stone because it is thought to contain material from stars and interstellar dust clouds preceding our solar system, as well as material from the earliest stages of the solar system's formation.

This fossil evidence, preserved in the frigid near-vacuum of space, will provide "cosmochemical" clues to the history of our solar system and objects existing before its formation.

It is proposed that the solar system was formed approximately 4.6 billion years ago from an interstellar dust cloud that contained material from previous generations of stars. As the interstellar cloud collapsed to form the inner and outer planets, dust in the most distant regions aggregated into icy planetesimals that were ejected into orbits greater distances from the sun. The Oort Cloud of Comets is estimated to be more than 10,000 times farther from the sun than the planet Pluto.

When disturbed by the passage of other stars or interstellar clouds, comets can be thrown into orbits that carry them closer to the sun. These small icy bodies, mostly water with dust and rocky fragments, have nuclei of only a few kilometres in diameter. The comet coma, a misty cloud vaporized by the sun's radiation, can be tens of thousands of kilometers in diameter.

More on Comet Dust Research

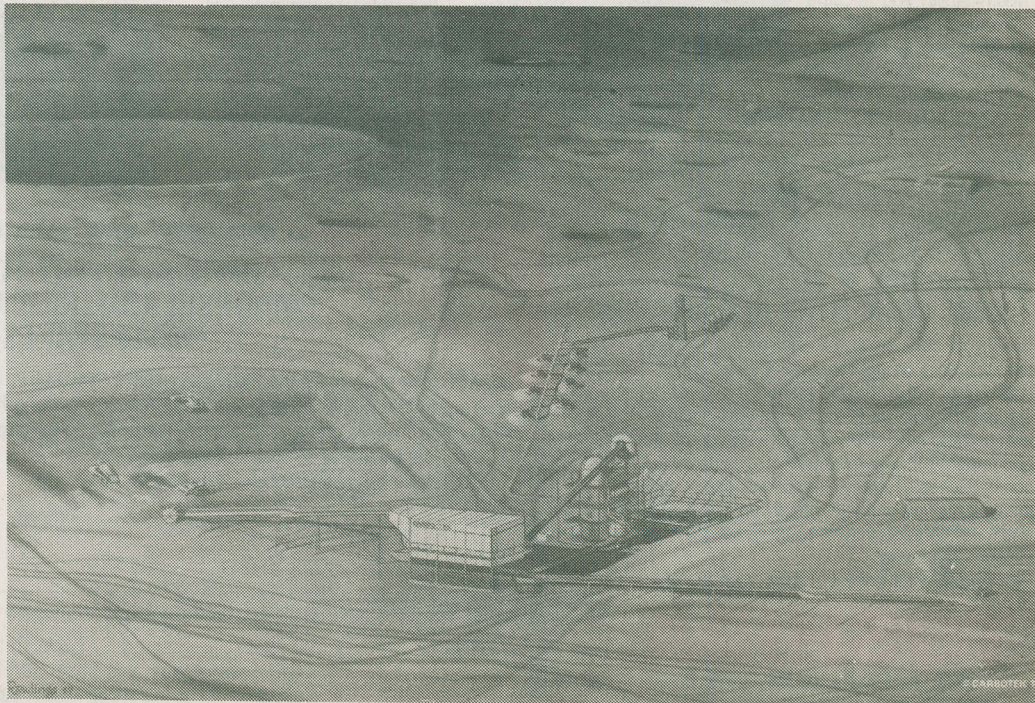
Is it possible that the spark that caused life to begin on this planet arrived in the tail of a comet?

It's anyone's guess and one that is raised by a recent discovery by Lewis Snyder of the University of Illinois, Patrick Palmer of the University of Chicago and Imke de Pater of the University of California at Berkeley. The researchers, as they report in an article in the *Astronomical Journal*, found an interstellar formaldehyde emission from Comet Halley, indicating that one key molecule in biological activity is transported in comet dust.

Snyder said that formaldehyde is one of the most complex molecules identified in star-forming regions, and the most significant one in biological development.

"We are investigating the chemistry that makes those molecules survive, and how that chemistry is delivered from interstellar space to Earth," he said.

A comet's tail carries dust molecules from the interstellar molecular cloud, from which the solar system formed, to the Earth. In fact, Snyder said, the most pristine material surviving today from the original solar



A unique method of extracting oxygen from moon ore may supply the needs of future moon colonies.

nebula is believed to be in comets, so determining the chemical composition of comets is an important problem.

So far, about 80 separate molecules have been detected, from simple two-atom molecules to more complex ones containing 13 atoms. "The gas and dust in a large interstellar cloud may have mass equal to a million suns, and this cloud material goes on to form stars," Snyder said.

"Debris is left, some of which may form planets, some of which remains at the outer edge of the solar system. A small fraction of this primeval interstellar matter may be formed into comets, which transport it to planetary surfaces."

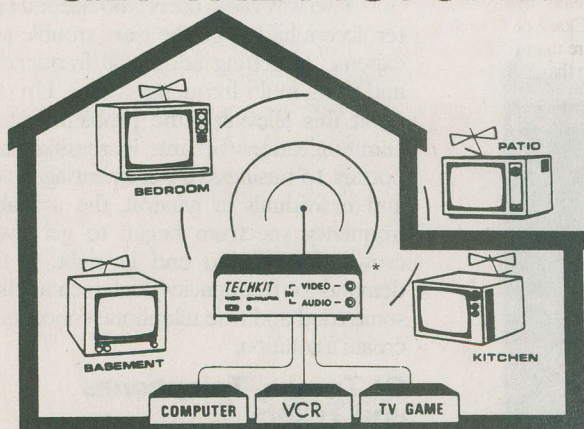
The scientists tracked Comet Halley over a three-day period in 1986. They searched for formaldehyde by using radio images from the VErY Large ARray, a series of telescopes at the National Radio Astronomy Observatory near Socorro, New Mexico. Their success, says Snyder, was "... an impressive demonstration of the potential of ground-based arrays for future cometary observation."

Next on their agenda, a continuing search for even larger molecular compounds in interstellar matter, which should help scientists understand the chemistry of the universe.



The European Space Agency's Long Term Program "Horizon 2000" will use a space probe to return samples from the nucleus of a comet, allowing scientists to analyze material from the earliest stages of the solar system's creation (photo courtesy of CRNS, University of Liege).

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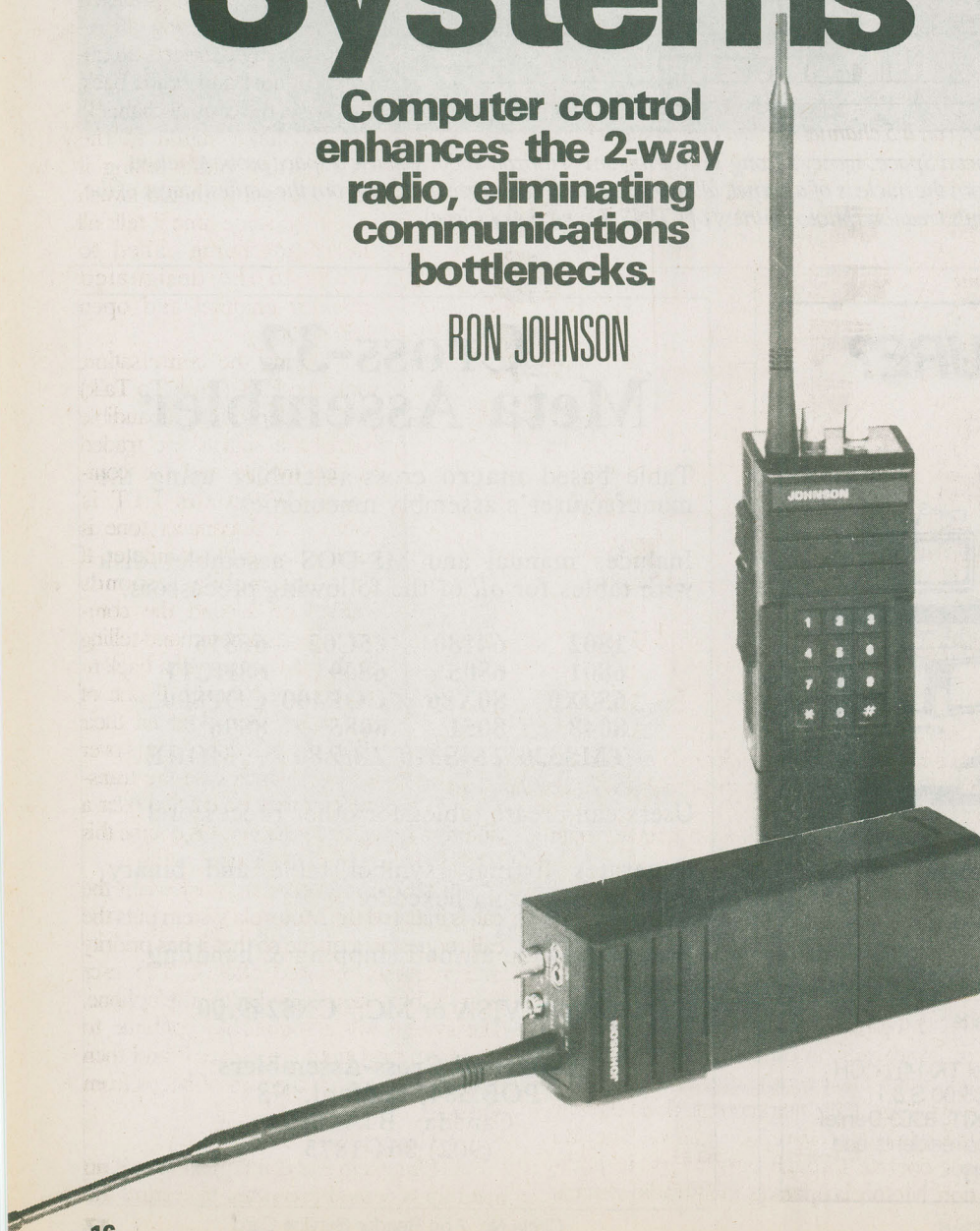
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Logic Trunked Radio Systems

Computer control enhances the 2-way radio, eliminating communications bottlenecks.

RON JOHNSON



Remember the old wooden crank telephone that used to hang on the wall of Grandma's house? You picked up the receiver and held it to your ear while talking into the carbon microphone sticking out the front. But first you made sure the party line was clear. (Before the days of television some of Grandma's best hours were spent "rubbering" on the neighbours' conversations.)

Until recently, two way radio systems operated in basically the same manner. A number of portable and mobile radios were linked together on a common frequency pair, often with a repeater to increase range. (Mobile radio systems use separate send and receive frequencies, the pair being referred to as a channel.) All radios shared time on the same channel and could be heard by all other radios.

The privacy problem was partially overcome by the use of various signalling systems. One such system allowed group calls by transmitting audio tones when the radio was keyed. Radios programmed to accept a particular tone would enable their audio (de-squelch) and the message could be heard. The problem remained that all radios in that system used the same channel. Overcrowding eventually caused blocking and simultaneous transmissions.

Two way radio users who needed better access had to go the extra trouble and expense of getting additional frequencies and using multi-frequency radios. Up to a point this alleviated the problem but as communications became increasingly important to business, government agencies, and individuals in general, the available frequency spectrum began to get overcrowded. With no end in sight to the demand for frequencies, high tech applied some tried and true telephone concepts to create a solution.

Of Trunks, Telephones and Tellers

The concept of trunking is not a new idea. Telephone companies have been using it for years. (That's why Grandma doesn't have a party line anymore.) What made radio trunking viable (besides the need for channels) was the availability of microprocessor technology to control the radios and repeaters.

The theory behind the concept can be understood by looking at a common analogy. You are at your local bank to cash that big paycheque you just received. You know that if you would have come in two hours earlier you could have walked right up to a teller and cashed your cheque. No

problem. But now the rush is on and there are lineups in front of every teller. You pick the shortest line, but very shortly realize that the guy at the front has brought in a sock full of change for the teller to count and deposit equally in each of his twelve children's accounts... you get the picture.

Meanwhile all the other lines are moving steadily ahead. Should you jump lines? Come back later? Shout fire?

An alternative approach is being adopted by most banks. Everyone waits in a common line and proceeds to the first available teller. The guy with the sock might tie up one teller for a while, but everyone else has equal access to the rest of the tellers.

This is the basic concept used in trunked radio systems. First come, first served. If there are more requests for service than channels available, you get in line and wait. Even so, with trunked radio the waiting is reduced while the capacity is increased.

The effectiveness of trunked radio is based on two fundamental characteristics of message traffic which have been used in the telephone industry for years:

1. The percentage of time that any individual subscriber uses the communications channel is small.
2. The probability that a large percentage of subscribers will use the communications channel simultaneously is small.

Loading and Blocking

Figure 1 represents the loading on a five channel trunked radio system. In this example the system has a 50% loading. If the system were not trunked, any radio trying to access his particular channel would have a 50% chance of being blocked. The bottom graph shows the times when all five channels are in use. These are the only times he would be blocked on a trunked system. It is obvious that he has a much greater chance of getting access on the trunked system.

A trunked system does not guarantee immediate access, but it improves the service and thereby allows more traffic per

repeater channel allocated.

Several manufacturers have marketed trunked radio systems for the 800 Mhz band. While the basic concepts are the same in each, the implementation of hardware and software varies. In addition to implementing trunking of several repeater channels, all the systems use some form of signalling to control audio. As in the earlier systems mentioned, sending codes in the form of audio tones or digital data enables only the radios programmed to the addressed group. Using selector switches on

themselves, selling or leasing radios and charging for service on their trunked system.

Second, their technology uses an approach different than most. On their trunked radio system one repeater channel is dedicated as a control channel. Under the control of a supervisory computer the control channel transmits current status of the radio system to the mobile and portable radios.

The information is encoded in the form of serial data. When a portable radio

is keyed a signalling data word is sent via the control channel to the central computer telling it the radio's ID and what group or subgroup the radio is calling. The computer, which is constantly monitoring all repeater channels, selects an unused channel and sends back, (again via the control channel), a handshake signal to the transmitting radio telling it what channel it should switch to. At the same time it tells all the radios being called to switch to the designated repeater channel and open their audio.

During the conversation, while the PTT (Push To Talk) switch is depressed, subaudible handshake signals are traded by the mobile and the computer. When the PTT is released a disconnect tone is transmitted to the computer. If no other mobile responds within one second the computer sends a command telling all the radios to switch back to the control channel. If one of the radios then does hit their PTT, the procedure starts over again in which case the transmission may be carried over a

different repeater frequency. Of course this is totally transparent to the user.

If all the repeaters are busy when the call is initiated the Motorola system puts the call request in a queue so that it has priority over requests received after it. The user hears a busy signal similar to a telephone. The system will automatically continue to attempt access until it achieves it and then notify the user with a series of beeps from his radio.

2. General Electric

GE's system is also unique. There is no need for a central computer to control the

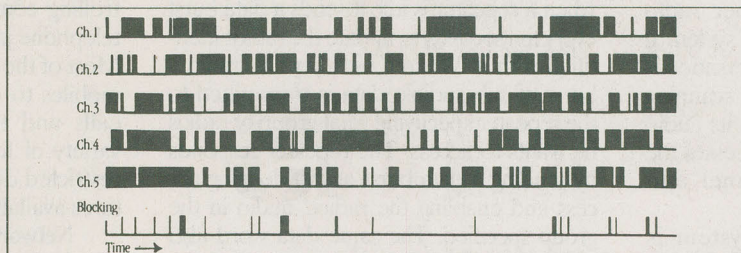


Fig. 1. The loading on a 5 channel trunked radio system.

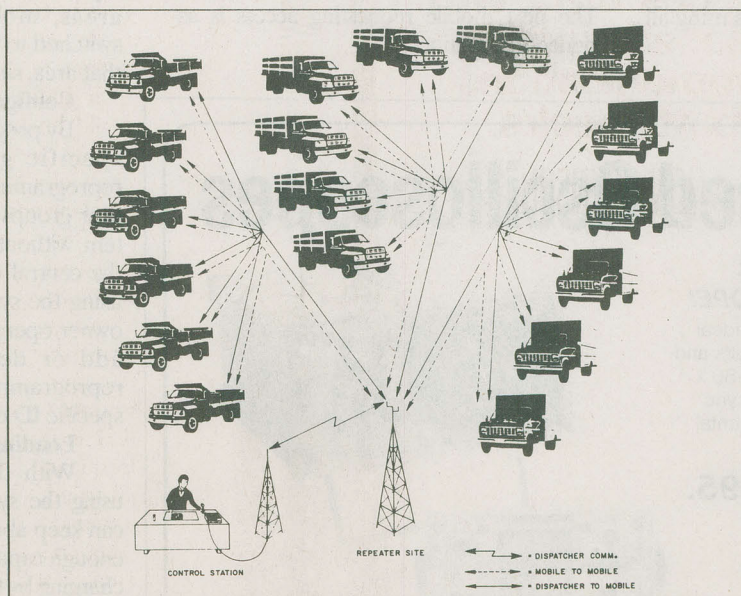


Fig. 2. The combination of repeater stations plus remote signalling of individual receivers allows much larger number of 2-way radios than was

the radios, a virtual multichannel system can be obtained.

What's on the Market?

The following is a description of some of the systems available:

1. Motorola

Motorola is the largest manufacturer of 2-way radio systems in the world. Their approach has been unique in a couple of ways. First, their marketing is done directly through Motorola representatives. They do not operate through distributors. In addition, Motorola operates many radio systems

Logic Trunked Radio Systems

repeaters. Instead, each of the radios has an on-board microprocessor which controls scanning functions on the radios. All radios scan all the available repeater frequencies looking for incoming calls.

To initiate a call the user depresses his PTT switch which causes the radio to locate an idle channel. A tone is sent to the repeater requesting access. When this is confirmed further tone signalling through the repeater alerts the other scanning radios that they are being accessed. Their audio is unswitched and voice communication proceeds. If another radio subsequently tries to access the system it already knows that the first conversation is in progress because it has been scanning through that channel even though its audio has not been enabled. It then accesses the next available repeater channel and proceeds as in the original case.

The advantage to this system is twofold: Cost is reduced by eliminating the central computer and even if one repeater channel fails the system continues using all the remaining channels.

3. Johnson

The Johnson system is the only logic trunked radio protocol which has been emulated by other manufacturers. Companies such as Bendix/King, Uniden, Kenwood, Americom and others have adopted and in some cases enhanced the Johnson signalling protocol.

This system operates using a smart logic unit on each repeater. These logic units communicate with each other via a coaxial data link. Each portable or mobile is assigned a "home" repeater on which it normally communicates. During the times when a repeater is idle it sends a data burst every ten seconds to update the radios identified with it. When a user keys his radio a burst of sub-audible data is transmitted to the repeater specifying what group of radios he wants to access. The repeater responds by sending a data burst acknowledging access and enabling the radios' audio in the group specified. The same data word also informs all other mobiles assigned to that home channel which other channel is free. The next mobile requesting access is assigned this channel.

More Features

So far we have looked at equipment which allows mobile radio users to make optimum use of frequency spectrum by sharing channels and by using digital signalling techniques. Computer technology is largely responsible for these features. That same technology can be used to provide a host of other features that Grandma would never have dreamed of.

Interconnect:

Add a DTMF keypad to the mobile, some hardware and software to the controlling computer, and plug into a handy telephone jack and you have interconnect. Most of the systems available will allow the mobiles to originate or receive telephone calls and the computer can provide a variety of features such as speed dialing, restricted dial out and other standard features available from your telephone.

Networking:

In large systems, where there are repeater cells in adjoining geographical areas, mobiles can be tracked and switched to the next cell as they move into that area, similar to cellular telephone.

Configurations:

By programming individual radios for specific group codes, (usually by reprogramming EPROMs) many varied user groups can operate on the same system without ever conflicting. In addition, the central computer can monitor who is using the system and to what extent. The owner/operator of the trunked system can add or delete users 'on the go' by reprogramming the computer to allow specific ID codes to access the repeaters.

Loading and Billing:

With the computer logging who is using the system and when, the operator can keep abreast of whether the system has enough capacity. Invoices can be generated charging by the minute similar to telephone long distance charges. Integrating this with a data base program facilitates efficient control of the overall system.

Efficient spectrum utilization, flexible control of communications, multi-user group operation, loading and customer data manipulation, interconnect, expandability. There are just a few of the benefits of trunked radio. Some of them benefit the owner/operator of the system, but ultimately it is the mobile radio user that reaps the benefits. And the growing number of trunked systems being set up across the country proves there is a demand.

But don't expect Grandma to buy one. She still enjoys rubbering on Saturday nights. ■

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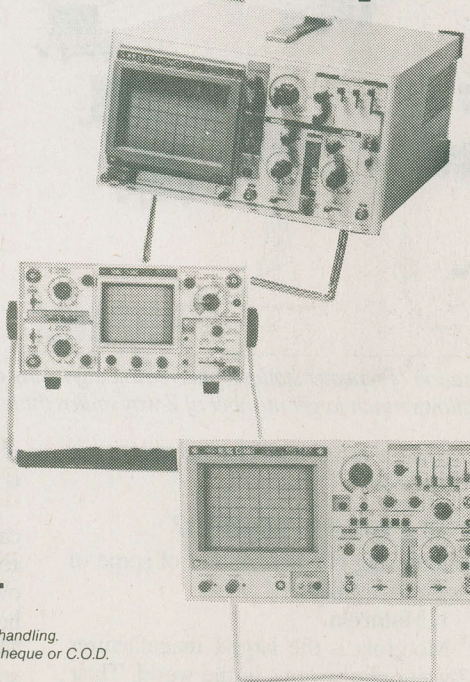
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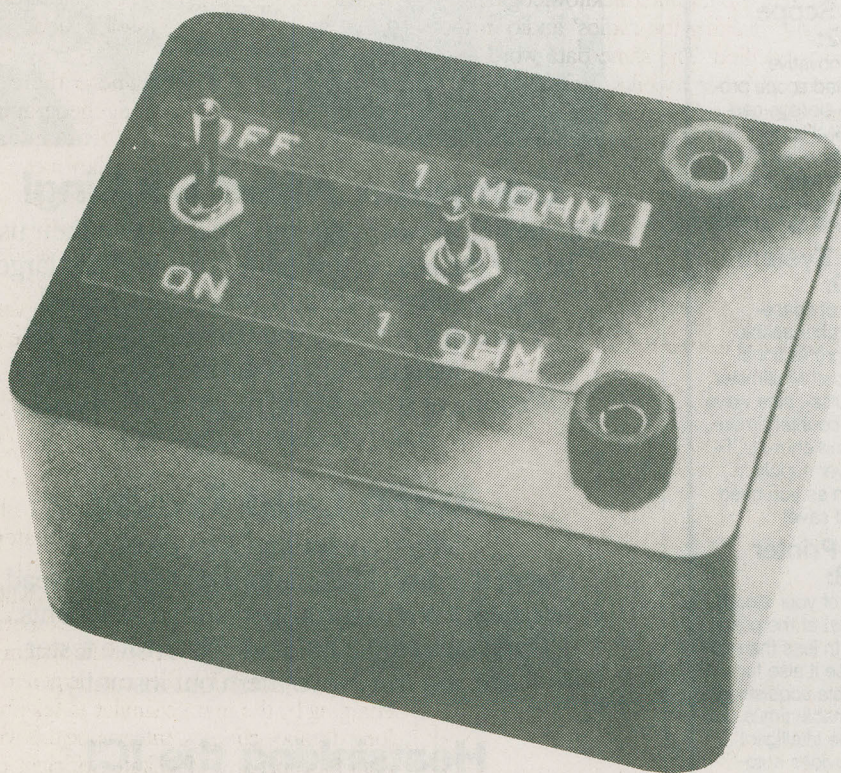
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JOHN RUGG



Most of us at one time or another have needed to use a continuity tester. Perhaps the most common domestic example is that of testing whether or not a fuse has blown in the plug of some household appliance. In this sort of situation, where the resistance of the component under test can be one of two widely separated values (*ie*, zero ohms for a good fuse, infinity ohms for a dud one), all circuit testers will perform satisfactorily.

For the home electronics enthusiast, things are never so simple. In any circuit, normal resistances are scattered over a very large range, so tracking down a fault is more tricky. For example, a continuity tester that operates an LED for resistances of less than 100 ohms will be useless if you are trying to confirm that a 47 ohm resistor is correctly connected.

Can continuity testers be this bad, I hear you ask? The answer is most definitely yes. Continuity buzzers fitted to digital multimeters (DMMs) typically show continuity for resistances up to a couple of hundred ohms, and one tester I used showed continuity for resistances of several kilohms.

This really begs the question of what we expect a continuity tester to do. What might the characteristics of the ideal device be?

(a) The most important is that the device should be able to detect a short circuit. By my definition this means resistances of less than about one ohm (not 200 ohms). With this sort of performance we'll be able to find bad connections that have resistances greater than one ohm, and check that very low value resistors are correctly connected in any circuit.

(b) As well as short circuits, the device must be able to detect open circuits (say, greater than about one megohm). This is ideal for checking isolation between tracks on a board (Verostrip, etc).

(c) Diodes and transistors should not cause the device to give false readings (a diode is not a short circuit).

(d) The device should consume no power and occupy no space. This means you don't have to buy batteries very often and it fits in your pocket.

Basic Principle

The fact that we have to decide whether the resistance between the test probes is greater than or less than a certain value (one ohm or one megohm), means that we are performing a comparison. This im-

Continued on page 22

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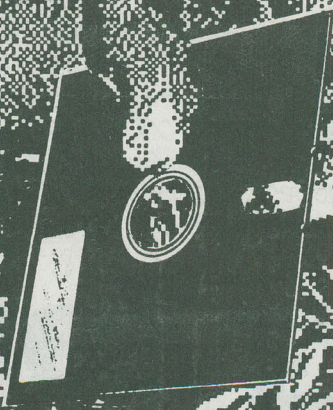
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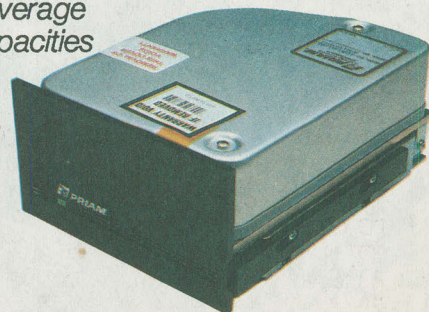
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ALMOST FREE™ SOFTWARE

VOLUME 1

PC-WRITE An earlier, compact version of this well-known word processor — perfect for program editing. PC-Write boasts features such as user-definable help screens and a 'printer ruler file' which can be customized to work with virtually any printer.

SOLFE is a small BASIC program that plays baroque music. While it has little practical use, it's a lot of fun. It's also a fabulous tutorial on how to use BASICA's sound statements.

PC-TALK A high-power telecommunications program for a low-price. It does file transfers in both ASCII dump and MODEM/XMODEM protocols. And, it comes with a large documentation file.

SD This sorted directory produces displays which are a lot more readable than those spewed out by typing DIR.

FORTH This is a small FORTH, written in Microsoft BASIC. A good tool for teaching the ideas and concepts of this esoteric, but useful language.

LIFE This is an implementation of the classic ecology game written in 8088 assembler code.

MAGDALEN This is another BASIC music program.

CASHACC is a fairly sophisticated cash acquisition and limited accounting package written in BASIC. It isn't exactly BPI, but it's a lot less expensive and suitable for many small business applications.

DATAFILE is a simple data base manager, written in Microsoft BASIC.

UNWS Convert WordStar documents to standard ASCII files.

HOST2 This program includes BASIC source and documentation files to allow users with SmartModems to access their PC's remotely.

\$19.95

VOLUME 2

SWEEP is a disk utility which virtually replaces the DOS COPY, REN, TYPE and DEL commands.

WORLDMAP is a graphics program which draws a very detailed map of the world. It can display its wares on your monitor, or send them out to a dot-matrix printer. CGA required.

ANITRA plays Anitra's Dance by Edvard Grieg. A beautiful addition to your computer music collection.

RAMDISK is one of the most useful utilities you'll ever plug into your PC. Once installed, it creates a virtual drive in memory on your PC.

ALIEN Plays a bizarre adventure game and will lead you into some of the most exotic spots in the universe.

FOS is a well designed personal

finance manager which will do much to help you tame your cheque books.

JUKEBOX represents yet another PC music system. This one comes with a host of songs and some really electric graphics.

ASMGEN is one of the best text disassemblers we've come across. It takes any executable COM or EXE file and produces an assembler listing. It's surprisingly good at distinguishing between code and embedded data or text.

STRUCT will appeal to the rabid programmer in everyone. It enables MASM to be used to assemble a higher level language. Included also is a test file to illustrate the syntax.

PRISC replaces the internal PC screen dump code with something more suited to reality. It allows one to hit the PrtSc* key and then select the print quality from a menu. It supports a number of popular printers.

BREAKOUT plays a PC version of the popular game. It will accept input from either a joystick or the keyboard. The graphics are good and the action is adjustable from a beginner's level right up to 'fast and nasty'.

UTIL is a collection system utilities which can be accessed from a single menu. Among its talents are a sorted directory, keyboard redefinition and the facility for scrolling through text files.

\$19.95

VOLUME 3

WRT DOS allows files to have a 'read only' flag, but it lacks a way of manipulating them. This pair of utilities allows you to set and unset this flag, protecting files from accidental erasure.

BROWSE is a timesaving program which provides a useful alternative to the DOS 'TYPE' command. BROWSE allows you to easily scroll through text files in order to have a quick look at a text file.

CAT If the DIR display is too dull for your taste, CAT may be just what you need. It will tell you everything you could possibly want to know about the files on your disks.

CGCLOCK is a simple little program which displays the running time in the upper right hand corner of your screen. Works with CGA displays.

CURSOR A tiny twenty-four byte program which displays a large cursor on your monitor.

CMP This program does a very elaborate comparison of two files and reports their differences.

JUMPJOE A bit like "Miner 2049'er", this game is certain to damage your mind. You get to be the janitor of a space station and deal with berserk robots and other weirdness.

CASTLE Wander through a deserted castle collecting treasures... but don't get killed by the nasties. A solution is

included should frustration set in.

78INT This small BASIC program calculates interest using the rule of seventy-eight.

MOON is one of the nicest lunar lander games we've come across. This version uses high resolution graphics and startling sound effects to hurl you to your doom in style.

PERTCHT is a BASIC program which prints PERT charts. It should interest anyone involved in project management and scheduling.

DATNOIDS is one of the strangest games ever put on a disk. In fact, mere words don't serve to describe it: you'll have to try it for yourself.

NUK-NY This is one of the nastiest bits of software we've seen. It produces a full color high resolution simulation of a nuclear attack on New York City.

\$19.95

VOLUME 4

BACKSCROLL Perhaps one of the cleverest DOS utilities, BACKSCROLL hooks itself into the PC and buffers whatever scrolls by. Using a well-thought out command structure, it allows one to scroll through text which has already scrolled off into oblivion.

BIGCAL is a BASIC program which performs calculations on extremely large numbers.

BUGS is an off the wall ASCII game in which a player uses the cursor pad keys to move a 'nuclear fly swatter' around the screen blowing up a bug.

CRYPTO is a BASIC program which unscrambles cryptograms. It's an great study for puzzle enthusiasts.

DEFRAG is a utility that lets you 'defragment' your disks to make your applications run faster. The utility reorganizes a disk, connecting up the fragments of files created by DOS.

DOSEDIT enhances the command line facility of MS-DOS by creating a command stack. Instead of merely being able to recall a command with the F3 key, DOSEDIT lets you

use the cursor arrow keys to scroll through a whole stack of previously entered commands, re-executing the ones you need.

DUMP is a utility program designed to produce Hex dumps of object files.

FREE is a tiny file which tells you how much space is left on a disk... without having to view an entire directory listing.

KBFIX displays the status of the keyboard lock keys on the screen and expands the size of the keyboard character buffer to avoid losing bytes.

LABEL changes the labels on disk drive volumes. It's a simple utility, but useful if you use volume labels to keep track of your disks.

LIST is an improved version of the DOS TYPE command which shows you the contents of a file page by page.

MEMBRAN is the most sophisticated RAM disk program we've seen yet. It lets users install variable sized disks and provides control over several other parameters.

MONOCLOCK is a screen clock display program, designed specifically to work with monochrome displays.

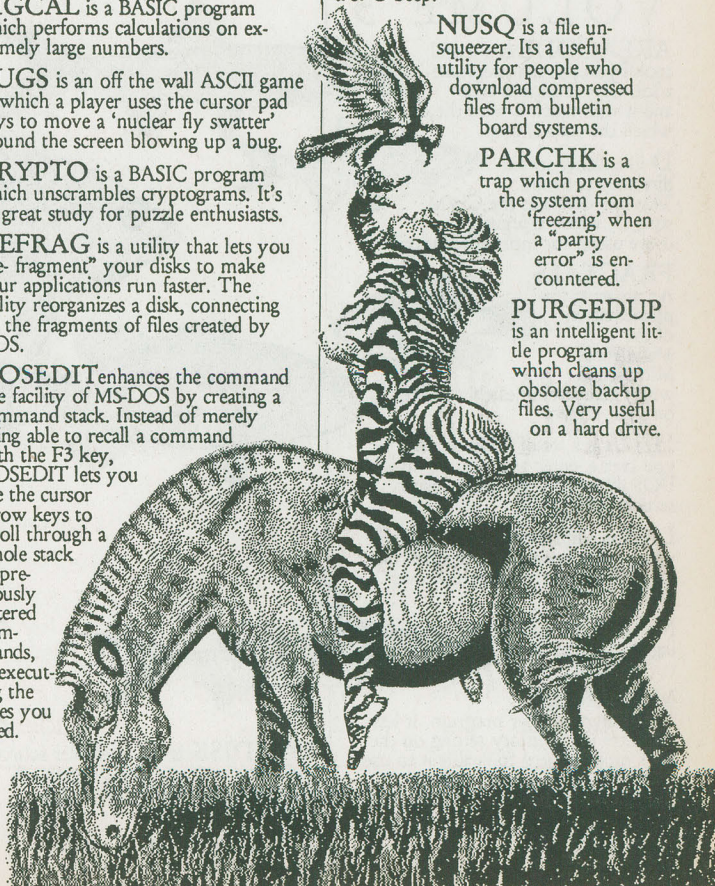
MOVE is a disk utility which moves and optionally erases disk files. Using wild cards, the user can ensure that specific types of files are not MOVED by the program.

NEWBELL is a tiny program which performs the lowly task of changing the sound of the PC's control G beep.

NUSQ is a file unsqueezed. Its a useful utility for people who download compressed files from bulletin board systems.

PARCHK is a trap which prevents the system from 'freezing' when a 'parity error' is encountered.

PURGEDUP is an intelligent little program which cleans up obsolete backup files. Very useful on a hard drive.



PX is a cross reference generator for assembler programs. It helps you keep track of where you put procedures in large files.

QS is a DOS patch which eliminates some of the wait encountered when DOS is booted while it performs a number of system checks. The program is not compatible with all software, but is still handy to have.

SDIR is an improved sorted directory program.

SP is a clever print spooler which lets you 'print' files into a RAM buffer, leaving the user free to move on to other tasks using the computer.

SPACE INVADERS A fast variation of this popular arcade game. The graphics are superb.

SPEED is a simple program which changes some of the PC's floppy disk parameters and effectively speeds up disk accesses for some applications.

VDEL is a multiple deletion program that queries the user prior to erasing each entry. Similar to **MOVE**, but much smaller.

WHEREIS will locate a file on a disk even if it lurks in a subdirectory. Most useful on hard disk systems.

WIZARDS is an adventure game in the classic style, except that it ranks as one of the most sarcastic programs in creation. The program is vast... you can wander about its darkened corridors for hours.

\$19.95

VOLUME 5

AREACODE is a useful tool if you use the telephone a lot. Give it an area code and it will match it with the city in which the code is used.

D in another sorted directory program. This one emulates the CP/M style D, which is arguably more useful for most applications.

FRACTALS An amazing implementation of the Mandelbrot Microscope, which generates unearthly images on your screen.

HIDE is a set of utilities which let you create, enter and remove invisible DOS directories. An inexpensive security strategy.

LAR is a library utility that allows you to concatenate several small files into a library to save on disk overhead.

MAIL1 is a mailing label utility written in BASIC.

MORERAM This is an assembler program. It lets you alter the memory setting on the PC's motherboard to enable it to use more than 640K RAM. MASM & LINK Required.

MORTGAGE generates amortization charts.

MXSET lets you control the

parameters of Epson printers from the DOS command line.

PARCHK is an assembler program which requires MASM and LINK to work. It installs a trap for parity errors in your computer.

VDEL is a Delete with Verify program.

WHEREIS finds files in a complex hard disk system.

ZAXXONPC This is an incredible implementation of one of the most popular micro games ever created.

\$19.95

VOLUME 6

3-DEMON is one of the most interesting variations on Pac-Man in the known universe. Instead of simply looking at a map of a maze, this program shows you a three dimensional view of it.

DU allows you to see what the tracks and sectors on your disks look like, recover erased or damaged files, and meddle with the system tracks.

GENERAL LEDGER This is a complete general ledger accounting program. Written in BASIC, the program possesses most of the features found in commercial packages. Documentation included.

PC-CHESS is a slick chess program which makes good use of the PC's colour graphics abilities and boasts a running chess clock.

TYPE and even run programs... in short, it does almost everything DOS does but it's user-friendly.

QMODEM is a sophisticated telecommunications program that includes windowing, multiple protocols, and definable function keys.

ARC is a clever file archiving program which stores multiple files in single library files.

ZAPLOAD is a utility for programmers to handle Intel standard HEX files. Very fast and well documented.

SOPWITH Using superb graphics, **SOPWITH** lets you pilot a World War I biplane on dangerous bombing missions.

JSB Another BASIC music program for your collection. This one plays a soothing sonata.

STAR is one of a growing breed of small... somewhat silly... novelty programs. This one, as you might guess, draws stars.

SURFACE demonstrates the complexity of the "hat" function by graphing it.

OP is the operator program from the November '85 issue of Computing Now!

\$24.95
(2 Disk Set)

VOLUME 7

BLACKJACK is a BASIC implementation of this popular card game.

EDSCR is a screen editor which can be used with virtually any programming language from assembler to dBase III.

FK allows you to make the function keys of your PC do more useful things under DOS.

FXMASTER is a printer program for the popular Epson FX Series and compatible printers. It uses a full screen menu to enable you to easily change printer settings and modes.

INDEX allows you to generate indexes from WordStar documents... or text files from any other text editor.

KEYCLICK is a memory co-resident program which will make your keys click.

PCBW is a small utility which makes colour screen displays show up in monochrome video. Great for users with colour graphics cards and monochrome monitors.

PINBALL is a pinball simulation that is easily worth the cost of this disk.

QUICKGRAF is a powerful business graphics package which generates complex bar, line and scatter charts in medium and high resolution. An Epson with GrafTrax or compatible printer is necessary to produce hardcopy.

SERPENT is a variation on the classic snake game. Written in BASIC, this one is weird, but very fast.

SHOWCLK is yet another clock program... its the smallest one yet, and it beeps to chime the hour.

VTREE is a graphic **TREE** program that shows you how the subdirectories are set up on your disk... in a fashion more easily understood than the MS-DOS **TREE** utility.

WORLD is a great program which allows you to zoom in on specific areas of the globe, locate major cities and perform a number of useful calculations.

\$19.95

VOLUME 8

DDCAL is a very clever perpetual calendar and desk diary. It keeps track of your appointments and performs several other functions.

PC-KEY DRAW is a great public domain paintbox program which compares favorably with many commercial applications. It'll handle multiple screen images, business graphics and superb computer art — all in full colour.

CPU is a tiny program which tells you the effective speed of your system.

XRAY is a remarkable co-resident utility which monitors what a program is doing while it's busy doing it. It allows you to interrupt the execution of your code and a look inside.

GAME — well, there are no words for this program, or, at least, none that are printable. It does use some suggestive language, and we recommend that young or sensitive users not boot it.

TUNE is a very small music generator which makes noises from within batch files.

CHASM, or cheap assembler, is just the thing if you want to get into assembly language programming but don't want to spring for the Microsoft macro assembler package.

GETDIR is a resident directory utility. It allows you to see what files are on your disks, even if you're in the middle of doing something else.

COPYPC, not to be confused with the commercial Copy II PC, is a quick disk backup utility.

LOOKIT is a browsing program that lets you scroll forward and backwards through text files — like a tiny word processor with no editing features.

SYSLOCK is a security device for hard disk users. By running this utility on your XT or compatible, access to your computer will only be granted to users with a valid password.

\$24.95
(two disk set)

VOLUME 9

SMALL C is a restricted implementation of C, producing code which is compatible with Microsoft's MASM and LINK programs — you'll need these to get it going.

MAP is an interesting little utility which will check how DOS is situated in the memory of your computer and tell you a number of things about it.

NOTE is the source file for the memory resident note pad which appeared in the March 1986 edition of Computing Now! It requires MASM and LINK to use.

PANGO is one of the wildest games we've come across for the PC. While its premise is a bit improbable, it's fast and weird — hours of fun.

PC-SPELL is a spelling checker written in BASIC. It's fast, accurate and easy to use. It can be listed if you want to see how it works, and comes with a large dictionary file and a utility to assist you in customizing it.

PEACOCK is a memory resident program which allows you to change the colours of your screen with alternate function keys.

RECOVER is a file recovery utility. It lets you look at your files one sector at a time in order to put the pieces back together.

SDB is a small relational database. It isn't dBASE III, but it also doesn't cost quite as much.

TALLY is a program which accurately counts the number of characters, words and lines in a file — all within your lifetime.

XENO edits the tracks and sectors of your disks in a user friendly format — or, at least, one that doesn't lunge for your throat every time you boot.

\$19.95

VOLUME 10

MONOPOLY A good implementation of the classic board game. Great graphics and sound. Slightly sarcastic play.

D20 is the latest version of Steve's sorted directory program. This one uses DOS two calls and handles sub-directories.

EDIT is a lightning fast full screen editor, ideal for editing program source files, dBASE stuff or other ASCII phenomena.

BANNER takes mere text and prints it sideways on your printer — in gargantuan block letters that can be read from miles away if you have a good set of binoculars.

MORTGAGE is one of the nicest mortgage programs we've seen so far — lifelong debt and ruination has never been so well formatted.

QUICK speeds up your PC quite a bit by improving video response.

SPEECH is a rather remarkable little germ of code. It talks through the PC's internal squeaker speaker. The voice isn't exactly human, but it's understandable on most machines.

PC-AR is an accounts receivable package for the PC. It will take care of the records for a small or medium sized business quite well.

\$19.95

VOLUME 11

PAC GIRL is, predictably, a variation on the almost mythical Pacman game. This one moves fast, and plays much like the arcade version.

MENU lets you create a menu-driven tree-structured environment that is friendlier and more manageable than is DOS.

Z80MU is one of the most brilliant pieces of software we've ever encountered — free or not. It actually emulates a Z80-based computer running CP/M on the PC with no additional hardware — you don't even need a V20. It will run almost all CP/M software, including old favourites like WordStar and dBase and includes features lacking in both C/P/M and MS-DOS.

SERIO is the assembler file from the July edition of Computing Now! that implements an interrupt-driven terminal in higher level languages such as C. It's also suitable for use with compiled BASIC. Both MASM and Link are required to use SERIO.

BREAKDOWN is a peculiar program which takes meaningful text, analyzes it and generates meaningless, but profound-sounding prose from it. If you've been wondering if your co-workers really read your office memos and reports, try filtering your prose through this program. The effects will be astounding.

XMODEM is a C language implementation of the XMODEM file transfer protocol, from the July 1986 edition of Computing Now! It can be integrated into other programs to allow easy access to telecommunications facilities. This code requires SERIO (see above) and version three Lattice C.

GRABIT is the screen grab program from the July 1986 edition of Computing Now! It will make a useable text file from the contents of one screen at the touch of a key. MASM and Link are required.

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VOLUME 12

CV is a small utility for changing the volume name on disks.

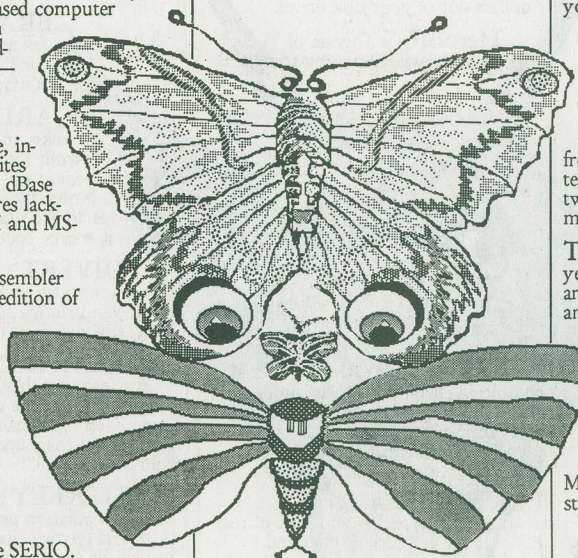
BREAKOUT BOX is an assembly language program that hides in memory and shows you what your serial ports are doing. It's a valuable trouble-shooting utility for pin-pointing serial printer and modem problems.

ICON MAKER allows you to generate sophisticated bit-mapped

images. It's easy to use and extremely colourful, producing data that can be incorporated into other programs.

SHELL is another DOS menu program. This one is very fast, free of 'snow', and provides easy access to virtually all DOS features.

STRIKER is an experience. It's a brilliantly written helicopter game in the style of Choplifter, complete with professional high resolution graphics and running spies.



RAMSET is a RAM expansion program from the July 1986 edition of Computing Now! It allows you to exceed the PC's 640K memory limit. Ramset also lets you bypass the PC's time-consuming memory check.

TRAP is the high-resolution Gemini patch program from the May edition of Computing Now! It makes the Gemini 10x suitable for use with Personal Composer, but is easily modified to fix most bit-mapped printing problems. MASM and Link are required to assemble the program.

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VOLUME 14

CUT AND PASTE is a memory resident program that allows you to grab text from the screen of any application and paste it into any other application that accepts characters for input.

INT13 will help you unravel the copy protection schemes of your software so you can make archive copies — just in case the cat takes a fancy to your masters. It prints a log of direct disk accesses and where they're called from so you can check out the code that's going after specific tracks, the heart of most protection systems.

PMAP tells you what's living in the memory of your system — and where.

It will help you to find the resident utilities you have loaded and, more important, is great for sorting out peculiar interactions between multiple resident programs.

SOFT TOUCH is a keyboard macro program not unlike ProKey. It allows you to store up to twenty five thousand key strokes, has a built in screen blanker and great wandering herds of other features.

SUB CHASE is a first rate graphics arcade game. One sails across the clear blue sea — or green sea, depending on what sort of monitor you have — heaving depth charges off the stern to blow up subs. Requires a colour graphics card.

TheDRAW is an ANSI screen editor. It allows you to create and edit full colour screens of text and graphics which can be displayed from DOS — in full colour — or integrated into programs. Requires DOS two or better, ANSISYS and is more fun with a colour monitor.

TREK is the best Star Trek game yet devised for the PC. The graphics are stunning, the complexity is intense and the action scoots along at warp nine as soon as the program gets going. Requires a colour card.

CROSSWORD is a utility which translates text files from one application to another. It supports several popular word processors, including WordStar, WordStar 2000, Multimate, XYwrite, SideKick and standard ASCII.

\$19.95

VOLUME 15

ALTAMIRA This is one of the nicest public domain paint box programs available for the PC. It does first rate pictures. Colour graphics card required.

FRACTAL This is the C source code for the fractal generator that first appeared in the August 1986 issue of Computing Now! Requires a C compiler and a colour graphics card.

NEMON This is a really weird game. You get stuck in the catacombs of king Nemon with nothing more than your wits and a flashlight. You have to find some keys, some treasures and, hopefully, a way around a host of arcade game nasties.

THOR used to be the god of thunder. Now he appears to be the world's most sophisticated desk calendar program for keeping track of appointments.

ROUND 42 This is bizarre variation on the theme of space invaders. One of the best computer games in creation. Requires a colour graphics card.

V20 is a CP/M emulator for users of the NEC V20 chip. Replace your existing 8088 with a V20, score this little program and most CP/M software will run on your system as if someone had stolen half the bits out of your PC. Regular MS-DOS isn't affected. Requires a V20 chip.

\$19.95

VOLUME 16

ARCDIR The archive file compression system is the most efficient way to store large files in a small space. This simple ARC directory utility was featured in the November 1986 edition of Computing Now!. It includes both a COM file and the source code so you can see how it works. Requires a C compiler if you want to meddle with it.

BRICKS The "Little Brick Out" game is one of the classic programs for microcomputers. This splendid version will get you turned onto simple games all over again.

DX This is a small DX-7 voice librarian, as found in the Book of Computer Music. It includes both a COM file and the assembler source code.

MOREROOM If you have a hard drive system you may have noticed that it's extremely inefficient with small files. Here's a collection of tricks to get substantially more space on your disk.

E88 is a tiny — but powerful — text editor. Neat and compact it is perfect for programming.

EXPERT Commercial Expert Systems software is still in its technological infancy. If you're interested in learning about expert systems and how they relate to your computing needs, you should try this simple program.

FULLDOS A DOS enhancement program that makes the DOS user interface behave in a rather more friendly manner. It creates a command stack and lets you re-execute previous commands.

K9 This is yet another resident keyboard enhancer — with a difference. Aside from expanding the keyboard buffer, installing a screen timeout and so on, it makes a number of the alternate keys 'hot', giving you dozens of unique functions.

InstantMENU This is the code for the Instant Menus article which appeared in the November 1986 Computing Now!. With it, you can create elaborate batch file menus without programming. Menus can be easily altered with a text editor or word processor. Source code is included.

PALERT We've all occasionally run out of disk space while inside an application and discover that we've been dumped back to DOS unexpectedly. This program warns you of an impending full disk.

\$19.95

VOLUME 17

ARC512 This is the latest version of the de facto standard PC file compression and archiving utility. It will

create, maintain and crack unpack ARC files. See the November 1986 edition of Computing Now! for more about this.

ATC ATC stands for "Air Traffic Controller". In this colourful simulation of the rigors of managing the planes at a busy airport may, among other things, renew your interest in train travel.

DRAW POKER This is a really slick little poker machine simulation. The graphics are good, the play is fast and the machine doesn't always win. It's a shame it won't spew silver dollars out of your disk drives.

HercBIOS This set of routines will allow you to



display text on a Hercules card when it's in one of its graphics modes — just as you can with a colour card. It will intercept the 10H interrupt vector so that anything that normally tries to print to the colour card will also work for the Hercules card.

HotDOS If you've ever found yourself wanting to run a second program without quitting your first application, then HotDos was made for you! Hit its control key combination from within most popular programs and it will give you a DOS prompt to run any other program at.

KBD This is a very tiny keyboard buffer extender. It's a useful few bytes to have around, and extremely tiny.

LinkFOUR A simulation of "Connect Four", this is a deceptively simple game. The graphics and sound effects are particularly good.

MONEY Yet another Canadian mortgage program, this easy-to-use program is surprisingly most colourful. It will also calculate charts for a variety of financial situations.

PCWINDOW This is a resident utility which lets you call up a number of useful "windows". These in-

clude an elaborate event timer, a note pad, an ASCII code chart and so on. It's well done, fast, and fairly small.

PD This program redirects the output of one's system from the printer port to a disk file. It lets you to use things that normally insist on having a printer on line even if you don't own one, or don't want hard copy.

\$19.95

VOLUME 18

BRADFORD A fancy printing program for Epson and Gemini dot-matrix printers.

CARD This is the draw poker machine program from the December 1986 edition of Computing Now!. It's included here both as an executable COM file and as source code in C.

DIVERT This is a tiny program which doubles the effective screen printing speed of most programs which print through DOS.

DONKEY KONG This is a pretty snappy public domain implementation of the classic arcade game. Getting squashed by oil drums is more fun than anything. Requires a colour card.

MASTERKEY is a public domain disk manipulation program that offers track and sector editing, unerasing files, and all the general low level fiddling that the expensive programs do.

PRINTER This is the PRINT-ER.BAS program from the December 1986 edition of Computing Now!. It reprograms the high end characters of an Epson FX-80 (or compatible) printer to make them print IBM PC screen block graphics.

QUICKKEY This little program speeds up keyboard action.

ZOARRE This is another dungeon game, but terrifically well done and very intricate. It displays a picture of the room you're in, zaps you with various monsters and generally tries its very best to kill you. If you liked Castle you'll freak over this one.

\$19.95

VOLUME 19

BOTH is a small utility which can slash your paper bill by allowing you to print long files on both sides of the paper.

DIAGS Written by the author of Z80MU, this collection of tools will be nirvana for the experienced PC programmer. It does things like generate an annotated list of all the interrupt vectors in your PC, let you meddle with the 6845 registers, test most of the ins and outs of your system and so on. It's a brilliant bit of work.

GRCP Graphic cut and paste is a memory resident tool that allows you to scoop things from a PC high resolution graphic screen and pop them into other applications.

LOCKERUP This tiny microbe of code sleeps in your system until you have to leave your PC for a while. Then it enables you to irrevocably lock up your keyboard until you come back to restart it. It's perfect for offices where there are more fingers than hands to contain them.

MEGAPEDE Just when you thought that it was safe to play ASCII games again... This one is a sophisticated variation of the classic "snake" programs and it plays with the speed of a boa constrictor. Don't count on winning for a while.

MURPHY Sort of an iconoclast in a can, this program will print a random selection of several hundred of murphy's laws, corollaries and commentaries thereon each time it's run. If you put it in your AUTOEXEC file it will say something clever each time you start your computer.

QUEBERT This fast PC implementation of the classic arcade game is every bit as exciting as the real thing but lacks a coin slot. Jump down the mountain, avoid the snake and try not to get clobbered with fresh fruit. Sounds like real life...

SAT This is a powerful, menu driven satellite data downlink terminal, as discussed in the December 1986 edition of Computing Now!.

SCAV This is a great program for people who buy economical floppy disks and just about everyone else who can't afford a clean room for their PCs. It cruises through one's disks locking out bad sectors and restores previously 'fried' disks to usefulness.

SimCGA The utility does an astoundingly good job of making a Hercules graphics card behave like a colour graphics adapter. It will let you run most CGA software.

STUFFIT Stuffit is a disk management utility which stuffs files into the inner tracks of a floppy disk, allowing the outer tracks to be used for work space. This improves the disk access times and the reliability of mostly full disks considerably.

\$19.95

VOLUME 20

ARTIFICIAL ART generates an ever changing graphic image on your PC — with accompanying sound. While it may seem a bit pedestrian, it's a gas to watch. Requires a colour graphics adapter.

AsEasy This is a public domain spreadsheet package, very similar in its abilities to the more popular functions of Lotus 1-2-3. Unlike Lotus, it doesn't cost anything and it isn't copy protected.

ASYNCR This is an assembler file which creates a device driver to make the PC's serial ports behave as they should, with interrupt driven buffered inputs and outputs. This is a programmer's delight. Requires MASM to use.

ChessII This is one of the best chess programs yet devised for the PC. Aside from being small and fast, it lets you physically pick up the pieces and move them rather than entering board co-ordinates. Plays an evil game, too.

HAUNT This is a haunted house adventure game. You wander around looking for the mysterious pumpkin man while picking up things, encountering ghosts and, if you're not careful, getting busted for shoplifting.

LPTX The most flexible printer redirection program imaginable, this thing lets you set up virtual printers, that is, disk files to capture the output of things that think they're printing. Includes both executable and source files.

PITFALL This is a supremely clever ASCII game. Aside from being an absolutely superb game in itself, it's a clever use of the PC's screen. You get to pilot a spaceship down a winding, rather nasty pit. More fun than being beamed into a supernova.

RAMDISK Once you've installed a normal RAM disk, it's there for the duration. This one allows you to change the size of the disk on the fly, or blow it away all together, without having to reboot anything.

ZAPDRAW This is the C source code for the Graphics in C article from the January 1986 edition of Computing Now!. It creates a general purpose high speed PC graphics library, suitable for use on both the colour card and the Hercules board. Requires Lattice C or something similar.

\$19.95

VOLUME 21

CACHE A disk cache program allows one to vastly speed up the disk access of a PC by stashing frequently used sectors in memory. This public domain cache program is extremely fast and fairly intelligent about which bits of oxide it retains.

COREWARS Perhaps the first program to truly embody the spirit of the phrase "computer game", Corewars pits two programs against each other. The object of the game is to crash the other code.

EMACS This is the latest word in well-executed programmer's text editors. It has multiple windows, macros and will even create a DOS shell for you so that you can skip out for a while to execute another task. Requires NANSISYS (see below).

MTS lets you run two applications, flipping back and forth between them at the stab of a key. This is the first one of these things we've seen that's bug-free.

VIEW This is the fastest full screen file browser in creation. It allows you to page back and forth through a file — it's much slicker than the DOS "TYPE" command. Requires NANSISYS (see below).

NANSISYS A replacement of ANSISYS, the improvements in the performance of your system that NANSI can produce are almost god-like. It includes a high speed screen driver and additional escape sequence screen handlers.

MIDIzap Figuring out the secret codes that drive some of the more sophisticated MIDI instruments is a lot easier if you have something to send and receive them with. This little

MIDI debugger runs with the popular Roland MPU-401.

SHELL This is a command.com replacement that implements a UNIX-like environment. It supports many features that DOS would like to have, and a much tighter command structure.

MUSIC SYSTEM This is a pair of programs which allow you to edit and play three voice music on the PC. These programs are not compatible with PC/ATs.

DEV This is a tiny utility that will locate the device drivers in your system's memory. It includes the assembly language source code.

\$19.95

VOLUME 22

CALENDAR This program prints up a calendar for any month in the twentieth century. It's very useful if you want to know which days people were being idle on in 1921, for example.

DFA This is a strange disk accelerator program which attempts to anticipate which sectors your software will call for and fetch them when the computer isn't busy. It can speed up some programs quite noticeably.

FSDEBUG lets you scroll forward and backward through a disassembly, set breakpoints, trace code and so on, all with a full screen display.

GRAB.ASM The source code for the graphics grab program from the March 1987 issue of Computing Now! Requires MASM to assemble.

SCROLL This is a resident scroll lock key enhancement. It's not all that exciting, but, then at 247 bytes, it's not all that big either.

SIDEWAYS This program lets you print awkward-sized documents sideways on an Epson printer.

PLAYSONG This is the source code for the linkable interrupt driven music playing package from the March 1987 issue of Computing Now! It also includes the MUSIC.C demonstration program. Requires MASM to assemble and a C compiler to deal with the demo.

ZAPDRAW2 This is the C language source file and updated header file for the text and graphics module from the February 1987 edition of Computing Now! It embodies several significant enhancements over the published version, including a writing speed increase of about 10 times. Requires ZAP 1.C from our Volume 20 disk and a C compiler.

PINBALL2 If you wasted a meaningful part of your life on the pinball game on our Volume 7 disk, this one will help you ruin what's left of it. It's the fastest, most colourful, weirdest pinball program to date.

MACSHOW This program allows you to look at Macintosh MacPaint image files on a PC. It will also print them and convert them to PC compatible bit maps. Several sample pictures are included. Requires a colour card.

WILLY THE WORM This is a fast graphic game in which you try to get Willy the Worm home. It's extremely strange.

\$19.95

VOLUME 23

ARCE A really tiny archive utility, this thing will extract members from ARC files without tying up half a disk for itself.

BABY An extremely warped game, this thing is engaging and fairly challenging none the less. It involves catching babies who are leaping out of a burning building.

CHMOD This is a useful utility for reading and changing the bits in a DOS mode flag.

CITYDESK This is an elegant fancy printing program that allows you to do some desktop publishing functions with a dot matrix printer.

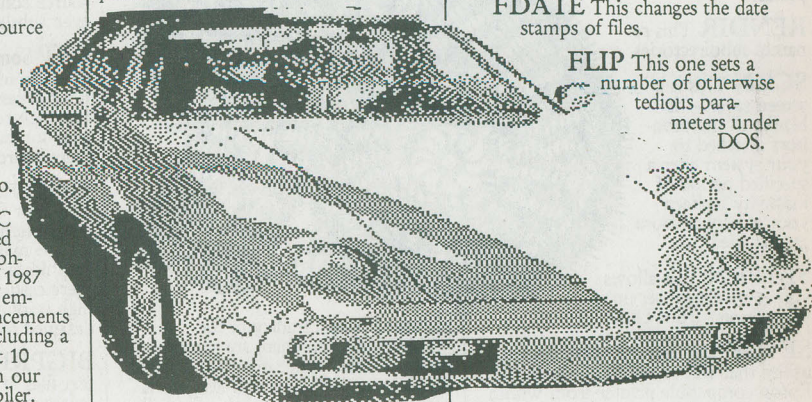
DOG A disk organizer, Dog will defragment the files on your disks to make them quicker to access.

FPR This is a printing program written in C. It's not compiled — you can change it to meet your needs. Requires a C compiler.

THRILL There is little to say about this program. It's a beautiful example of high resolution PC graphics, and was too good to ignore, even if it was wholly useless. It's also a bit naughty.

MIDI-IO This is the source file for the interrupt driven MIDI communication module from the April 1987 edition of Computing Now! Requires MASM to assemble and a language compiler to use — preferably C.

PC-WRITE The latest version of this phenomenal word processor, this thing is enough to turn you off any other word processing package on the planet.



EDWIN This is a decent windowing program editor written in Turbo Pascal. It's not terribly fancy, but it's fast and very much like WordStar.

\$29.95 (2 disk set)

VOLUME 24

AC This is a small area code program — give it a three digit area code and it

will tell you where it is.

ASC This is a memory resident utility that pops up a window with an ASCII character chart.

ATTR This utility lets you meddle with the attribute bit of your files.

BAC This is a disk backup utility that is much less frightening than the one that comes with DOS.

BACKSRL This recalls stuff that has scrolled off your screen. It's neat if you can't seem to reach the NumLock key in time.

CAT This is a collection of disk utilities in one program.

CLOCK One of the nicest clocks we've seen, this has a built in alarm function among other things.

COVER This is a sorted disk directory that prints out all the files on a floppy in a form suitable for sticking to the sleeve.

CWEEP This is a menu driven file mover — saves typing the word COPY over and over again.

DDIR Yet another directory utility, this does a two column directory similar to the regular single column DOS version.

DELZ This wipes out files so they can never come back — kills the sectors as well as the directory entry.

DISKCAN This one checks your disks for bad sectors — get 'em before they get you.

DOORS This lets you flip between multiple monitors without rebooting your system.

EQUIP This program tells you what hardware your system thinks it has — often providing you with the answer to many software problems.

FASTDISK If your floppies seem a bit tedious, you might want to zap 'em with this speed up program.

FDATE This changes the date stamps of files.

FLIP This one sets a number of otherwise tedious parameters under DOS.

FREE This returns the amount of free space on a disk without having to watch the whole directory scroll by.

GERM This is a memory resident interrupt driven communications terminal.

IBMSHELL This allows you to fool your system into loading COMMAND.COM from other places.

KBBUFF This is a keyboard buffer extender. No home should be without one.

KEYFAKE This allows you to "stuff" keyboard characters into an application to get past tedious introductory screens and menus.

LC This counts the number of lines in a text file.

LOCATE This scans through subdirectories, checking all the files for specific text strings.

LOCK This is a file encryptor. Also includes UNLOCK.

MOVE This moves files between subdirectories with less typing than COPY would entail.

NDOSEDIT An updated version of regular DOSEDIT, this is a resident DOS command line editor that actually makes DOS decent or work with. Indispensable.

NO This is a strange little wild card exception thing. It allows you to create more complex file specifications than does DOS all by itself.

NPAD This is a simple memory resident node pad.

PCUTIL This is a collection of add ons to DOS.

PINHEAD This is the printing press program from the June 1987 edition of Computing Now! It can get up to 16 kilobytes of text on one page. Includes the C source code. — works with Epson compatible printers.

POPCAL This is a memory resident utility which will bring up any month of any year you like.

PR This is a handy formatted printing utility.

PUSHDIR Primarily used in batch files, this allows you to change subdirectories, do something and then return to the previous directory.

REBEEP A replacement for PAUSE, this is a noisy batch file utility to attract attention when a task has been completed.

RENDIR This renames subdirectories.

SCRN This is a screen saver — it blanks all the monitors attached to your system after a specified period of inactivity to keep your phosphor from getting fried.

SETPRN This allows you to painlessly set up your printer from DOS.

SETUP This is a memory resident utility that will allow you to set up an Epson compatible printer from within any application.

SIZE This returns the number of allocation clusters a file occupies on the disk.

SOUND This makes weird noises to attract attention from within a batch file.

SP This is a really nice little print spooler.

SWEEP This allows you to execute a 4command in every subdirectory on your r disk.

UNDEL This recovers accidentally deleted files. You man not need it now but you sure will sooner or later.

VDL This requests verification before it deletes files so you won't need UNDEL quite as often.

VOLSER Changes the volume name of a disk.

WAITN This pauses for a specified time while executing a batch file.

WHEREIS This finds files in subdirectories. It includes the C source code from the June 1987 edition of Computing Now!

XDEL This is a menu-driven file deletion utility.

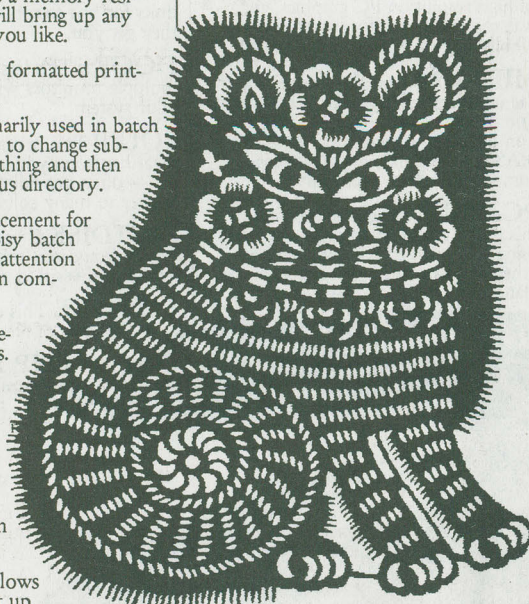
\$19.95

VOLUME 25

VMAC4 this little program allows PC users with Hercules compatible cards — or ATI multiple monitor boards — to look at MacPaint pictures. The Herc card has a more usable aspect ratio than the colour card, and the images look pretty slick.

PINBALL3 The weirdest pinball game we've encountered thus far, this thing will zap your brain if you play it late at night.

MAXHEAD This is a MacPaint



picture of Max Headroom for VMAC4, above. There are several more — rather more exotic — pictures on Volume 24, which will also work with VMAC4. Likewise, this file will work with the MacShow colour card program on the disk, which can be used to convert it for use in other PC graphic software.

SPKR A device driver, this little beast allows you to make the PC's speaker play music in a very elegant, program independent way. It's suitable for use with BASIC, C, Turbo Pascal, assembler and even just from DOS.

RESQ can recover erased files and, more important, it can find text that you've lost in memory due to a

software crash and get it back into a file. It's indispensable.

IT The "Ideal Terminal" is a telecommunications terminal package which emulates several professional mainframe style hardware terminals. It also handles XMODEM and KERMIT file transfers, making it a much less freaky replacement for the likes of QMODEM and CrossTalk.

RIGHT HAND MAN is a sort of enhanced public domain Side-Kick. It provides all sorts of pop-up utilities including an ASCII table, a really powerful calculator, a DOS shell and several note pads. It also handles keyboard macros.

SLOWDOWN A lot of software — mostly games — which has been written to run normally on a PC switches into maximum overdrive on an AT or even a fast PC. This usually makes it useless. The slowdown program allows you to bring the speed of such a machine back down to sub-light levels for these occasions.

\$19.95

VOLUME 26

AWS Programs that turn WordStar into ASCII abound, but this one turns ASCII back into WordStar. Let those high bits roll.

BADCLUST This program finds the bad clusters on cheap disks, preventing them from killing your data. If you must use low rent oxide, use it carefully.

CHEAPFMT Like BADCLUST, above, this program makes your life less freaky if you use cheap disks. It formats them very carefully, looking for unusable sectors.

CCC A C language programmer's dream, this is a "pretty print" program, that actually draws nesting loop and structure diagrams beside the source code it lists. It makes spotting even subtle bugs effortless.

CTP Something of a mutated fusion between snake and space invaders, this is a ruthlessly fast arcade game in first rate high resolution graphics. Requires a colour card or HGC, below, and a Herc board.

HGC This is the first colour card simulator for a Hercules board that really seems to have its act together for the majority of colour card graphics software. Run it and your Herc card will display colour card high resolution graphics as if it was designed for the task.

BIGPRINT This program prints text files in very large characters. It requires an Epson compatible printer.

MBS This is one of the nicer fractal programs we've encountered, as well as being one of the faster ones. It runs on a colour card, or on a Herc board with HGC, above.

MOUSE This is the source code for the linkable MOUSE driver, as seen in the July 1987 edition of Computing Now! It requires MASM to assemble and a C compiler to use.

PCRR This is one of the most interesting programs we've yet en-

countered. It simulates a railroad in high resolution graphics. You can lay out your railroad, equip it with multiple trains and make the whole party go. Requires a colour card or HGC, above and a Hercules board.

TASKER This is the most elaborate multitasking system yet devised for the PC. Install up to nine variable sized partitions, with a program running in each, and pop between them instantly.

WINDOW This is the source code for the C language window manager from the July 1987 edition of Computing Now! Written in Lattice C.

\$19.95

VOLUME 27

DECEIVE This is a resident program to be used if your boss likes to creep up behind you when you're supposed to be working. At the touch of a key your PacMan screen can be replaced by WordStar, Lotus or any other serious application until the powers that be are satisfied and play can resume.

DPATH Allows the opening and creating of files to be handled with a path, just as the running of programs is under DOS with the PATH command. This is the gift of the gods to programs that can't find their overlays and configuration files.

HXC A sophisticated hexadecimal calculator, this program will keep you from damaging your hands by trying to glue on four extra fingers.

IOMON This is a resident utility which monitors the disk I/O of your system and lets you see what the drives are doing. It's great for spotting the causes of system errors.

TREECOPY This is the best... and fastest... tree copy utility we've encountered to date. It will copy an entire subdirectory and all of its included subsubdirectories into another tree.

TREDEL This program will wipe out a whole subdirectory and any subdirectories in it with one command. Mass slaughter... what fun!

TREESIZE This program tells you how much space is occupied by the aggregate contents of a subdirectory.

VRAM This amazing bit of work is for people with programs that want to see a Lotus-Intel AboveBoard memory card...if they lack one. It allows up to eight megabytes of hard drive space pretending to be extended memory...sort of a reverse RAM drive.

LQPRINT is a nice print enhancement utility that works with many word processors and printers. It includes a wide selection of very well done fonts.

ZANSI Another replacement for ANSI.SYS, this one increases your console printing speed by almost fifty percent without sacrificing any of the commonly used ANSI.SYS functions.

CYLON This makes your cursor go strange... deliberately. Requires an EGA card.

EGARIDS The best asteroids

game ever written for the PC... when those rocks come at you, pray to the cosmic gods. Requires an EGA card.

KC-PAL An EGA palette editor and librarian. Comes with lots of support utilities and toys. Not surprisingly, it requires an EGA card.

NEWFONT Replace the austere, depressingly corporate IBM font of your PC with damn near anything you can think of. Several fonts are included. The screen interface is seamless, and the results can be extremely pleasing. Requires an EGA card.

\$19.95

VOLUME 28

ASTROLAB This is a very sophisticated program for working out the conjunction of the planets for any day in history. It's not much use if you believe in a flat earth, but handy for horoscopes.

BASERES Yet another resident utility, this thing will accept numbers in any base and show them to you in all the other commonly used notations. In other words, it will convert decimal to hex and back again—great for people with only ten fingers.

BREAKON This is a utility to make just about any program exitable with control-break. It has multiple levels of urgency—three hits gets you out of anything short of the end of civilization as we know it. Assembler source included.

CROSSWRD If you've ever wanted to generate your own crossword puzzles, this is the code for you. Fill it full of words and it finds places for them—keeps track of the clues, too.

DIMMER The smallest screen blanker yet—two hundred and seventy one bytes.

EPSONISM Even people with laser printers occasionally have to deal with plebs. This program is a DOS filter to make a PostScript printer behave like an Epson.

FASTBIOS This is a pair of programs which will extend your keyboard buffer—without hanging your system—and increase the speed of your screen dramatically.

FREERAM This will tell you the truth about how much useable memory is available to your programs.

LASERGRID This is a rather good ASCII game. Place your bets and hope the aliens leave you alone.

VMUSIC This is a small three voice music player which handles its scores in BASIC music notation. Comes with several songs, and you can easily create your own tunes with a text editor.

IDCKEYS This is an assembly language program to set up the function key redefinitions under ANSISYS. It's great if you like to have keyboard macros under DOS without a keyboard redefinition program installed. Requires an assembler to use.

IDCKILL This will go through an entire hard drive—including all your

subdirectories—and kill files that match a given specification. A bit nasty if you use it improperly, but great, say, for snuffing BAK files.

LW86 This is an extensive pop up reference card for assembly language programmers. It includes explanations of the op codes, what the assembler directives do and so on, all at the touch of control shift.

SPACE Find out how much useable space is on your hard drive instantly. Includes assembly language source.

YESNO A really useful thing to create complex interactive batch files, this little program returns an error level code basic on the ASCII value of a key press. Assembly source included.

\$19.95

VOLUME 29

INSTACALC is a memory resident spreadsheet. It may not be Lotus or Excel, but it's amazingly powerful considering that it lives in an alternate key combination. Includes a sophisticated macro facility.

ALTER allows you to change the attributes of a file... including the time and the date.

CALENDAR is a sophisticated desk calendar which can be made memory resident if you want it to be. It uses data files which allow you to have it remind you of things.

COVER prints disk directories suitable for sticking into the sleeves of your disks... the nicest such program we've encountered. Requires an Epson compatible printer, patchable with DEBUG for other printers.

DISKLITE is a tiny bit of code which shows you when one of your drives is running. Not much use for floppies, this, but great for RAM disks and AT style internal hard drives.

DISKUTIL is a poor man's Norton utility. It will walk you through simple disk level functions, including FAT table fix ups and file unerase.

MELT clears the screen, dramatically.

MONSTER a memory resident DOS monitor. Check out what your programs do one INT 21 call at a time.

THEGRIN is the most sophisticated MacPaint picture viewer yet. It allows you to stretch and compress images, zoom in and out and generally hack their bits to bits. It also prints them.

TMAP is a clever TSR program mapper which is itself memory resident. It's superb for finding gorges caused by interacting resident programs.

VARISLOW is a variable speed control for AT type computers. It lets you crank the clock down to play games at their normal speeds. However, you can do it interactively, rather than from a command line.

WATERFALL is a fabulous MacPaint picture of an Escher drawing, suitable for use with THEGRIN or any other MacPaint reader.

CHINASEA is a James Clavell novel in a disk file. In this game you get to be a trader in the far east. Try to prosper without getting knifed.

TURBO C PATCHES

is a collection of patches to fix some of the bugs in the early releases of Borland's Turbo C. If you're going to compile at warp speed you'd better have one of these.

\$19.95

VOLUME 30

386BUG Some 80386 chips don't

work quite right. They have problems with integer multiplication, which can cause some software to behave unpredictably. This Little program spots the duds... it's essential if you're thinking about buying a 386 machine. Includes source code.

MASM-MAC This is a collection of MASM assembler macros to make BIOS, DOS and 8087 interfacing a lot easier. Requires MASM to use.

8X6 installs a really tiny screen font on an EGA card. You can get about four times the usual amount of text on your screen with this if you run applications which support it.

AT is a little time bomb program. It will hide in memory and run applications at specific times and dates without any attention. Allows for queuing up several tasks.

BACHMIN is a three part Bach minuet in BASIC... quite the trick.

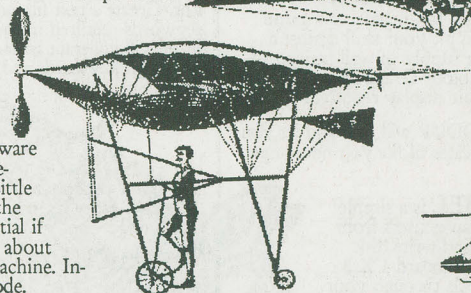
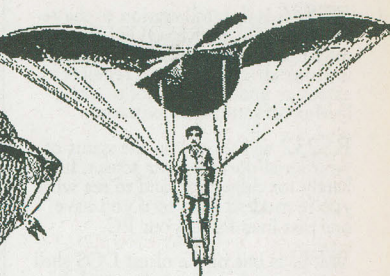
CAT is a small sorted directory program. While hardly high tech, it is a useful replacement for DIR.

CAVERNS is a fast graphic arcade game. It looks a bit simplistic but it will surprise you when you get into it. Wants a CGA card.

CMOS is a pair of simple programs which read the contents of an AT's CMOS memory into a disk file and then restore it. This is great for changing batteries, of course, and also for those systems with funky memory which require frequent setting up.

DIRNOTES allows you to attach short, one line comments to the directory entries on your disks.

PRTSCEGA is a program to make the PrtSc function work properly for EGA cards, allowing you to once again dump screens to your printer. Versions are included for a stock Epson FX-80 and for the Tandy DMP200. In addition, the source code comes with it, so you can hack a driver up for your specific printer.



EDISK allows you to put a RAM disk in the space between your normal system memory and your screen buffer, using this otherwise wasted space for something practical. It requires that you have memory in there, of course... many RAM cards will do.

EMC is an extended memory cache. It allows you to use LIM memory for a disk cache, speeding up your disk accesses without robbing your system of any main memory.

GDIR is a sorted directory program with uses the Hercules card's graphics mode to put forty-three lines of listings on the tube at once. It's very slick.

HELP is a slick little DOS help program which can be called up any time you need something about the PC explained to you.

THRASHER is a splendid system to find out the optimum setting for the BUFFERS line in your CONFIG.SYS file. It can speed up your disk accesses while actually freeing up a bit of memory.

MCSCOOP is the executable version of the MacPaint file reader in the Jan. 1988 edition of Computing Now! It also prints picture files... to PostScript, LaserJet+ and Epson printers.

LDRES is a system to make somewhat standard COM files into memory resident utilities, or TSRs. Please note that while full documentation is included with this thing, it's still a bit technical and you'll have to be a moderately decent hacker to make something come of it.

NOREBOOT will disable the Ctrl-Alt-Del reboot of your system. Source code is included.

RES86 is a transliteration of the redoubtable CP/M RESOURCE machine language disassembler. Source code is included. This program requires an extensive understanding of machine level programming to be useful.

RS232 will show you the status of your serial port on your screen. It's handy for debugging, and to see what you're modem is up to if you have one that lives inside your PC.

WFU is one of the nicest DOS shell managers we've yet encountered. It handles tagging, copying, deleting, renaming and generally manipulating files just as you would with the command line... but it does so in a convenient, menu driven environment.

\$19.95

VOLUME 31

NINJA is a fast martial arts game that lets you pit your skill against a neverending supply of well trained adversaries. Colour Graphics Card, EGA or compatible display required.

DDUP DDUP will find and let you delete duplicates of file you never new you had!

DIRLABEL is a simple utility that saves users from having to hand-write disk labels. Feed standard 1 X 3 1/2 inch labels through your printer and start DIRLABELing your floppies.

MADNESS If you thought you were going crazy, you haven't played Madness. MADNESS is an adventure game for the mind. Enter a land of shadows and mirrors, where reality is little more than a hazy concept.

PM is a handy co-resident phone message utility. Just pop PM onto your screen and enter the particulars of each call. PM inserts the correct date and time and appends each message to an ASCII text file that can be printed later.

RUSHHR is one of the strangest games ever created. Play traffic computer by juggling the timing of a series of traffic lights in a busy downtown core. You control the number of cars that are able to get through each light.

SPEED performs a detailed system speed test - similar to the "SI" test provided on the Norton Utilities, only better. SPEED shows you speed statistics for a host of register and memory operations such as arithmetic calculations and block memory reads and writes.

FREECELL This is an unusual solitaire game. Great graphics!

HDSENTRY is a resident utility that intercepts destructive calls to hard drives. Run HDSENTRY before trying out public domain software of dubious origin. It tries to prevent Trojan software from destroying the data on your hard drive.

\$19.95

VOLUME 32

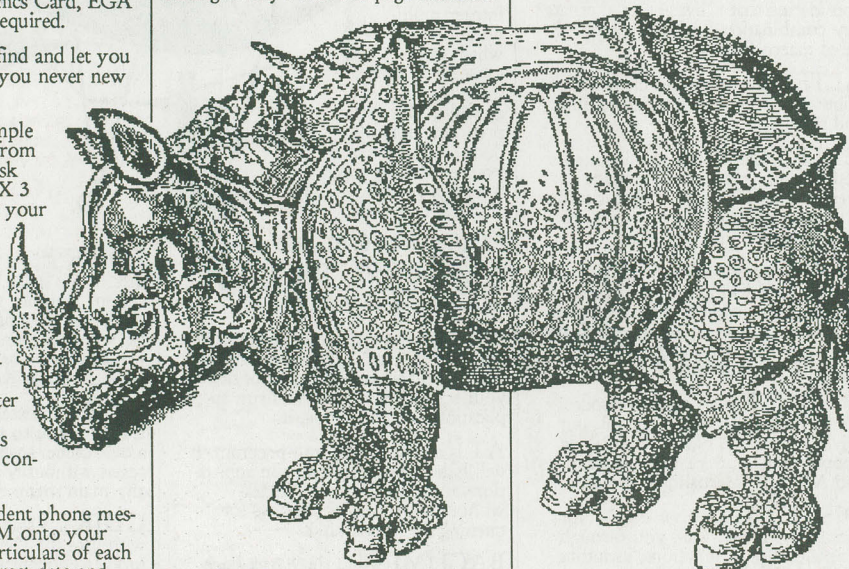
ARCTOOLS is a front-end menu utility for the popular PKXARC/PK-ARC archiving utility (available on SuperDisk 1). ARCTOOLS makes it easy to view and extract archived files.

CMPDIR is a simple utility that simplifies comparing files in different subdirectories and drives. CMPDIR can be a real timesaver when you need to identify files with the same name and different date/time stamps.

FCU is a financial calculator. Use it to quickly calculate interest, rates of return, loan amortizations and many other common financial calculations.

CARSIGN is a silly program that lets you create diamond-shaped "carsigns". Requires an Epson FX/MX or IBM Graphics compatible printer.

INDEXER is a flexible index generator. Create a text file with all keywords required in the index and indexer will generate an index file containing all keywords and page numbers.



VACINE is a utility designed to prevent "virus" software from infecting you hard drive and DOS disks. VACINE can tell you if the COM-MAND.COM and DOS system files have been tampered with.

FREE is a memory utility which reports on how much RAM is available in your system. This one also reports on Extended Memory (above 1024K).

PRUFREAD is a specialized file browser designed to speed proofreading. A highlighted bar remains stationary in the middle of the text screen, making it easy to focus on one line at a time in the text.

FKEYMAP is a utility for printing Function Key templates (for keyboards with function keys vertically oriented on the left-hand side) Great for new users. FKEYMAP includes templates for Word Perfect and Lotus 1-2-3 version 1A.

APRIL is one of the strangest "April Fools" software pranks ever created. Slip it into a friend's AUTOEXEC-BAT file and see what happens. Completely harmless fun. Colour graphics

card required. Also works with SIMCGA CGA simulation utility.

DVICEMAP is the most comprehensive utility yet devised to map memory locations of DOS system devices. This one also shows the order in which devices have been loaded, attribute words and interrupt locations.

\$19.95

VOLUME 33

READRITE is a co-resident "readability checker". Based on a formula developed by Rudolph Flesch, READRITE can be called up to analyze text. It will provide a readability index that relates syllables per word and words per sentence.

SPACEWAR is a fantastic space battle simulation. It comes in both CGA and Hercules versions and has stunning graphics and fast play. Loads of options!

MFRACT is a simple fractal gener-

ator that can display an endless variety of "mountain" fractals. CGA required.

MRORGAN is an unusual co-resident utility that turns your keyboard into a mini organ. It will really jazz up your favourite word processor. Great for office concerts!

FREEBYTE is a small and fast utility that tells you how much free space remains on your hard drives. Yes drives. It's smart enough to check space on large capacity drives with multiple partitions.

CHESS2 is a chess game that works with Microsoft Windows (version 2). Great graphics, but it's for two players only. MS Windows required.

DIGICLOCK is a handy digital clock for Microsoft Window (version 2). Windows required.

FREEEMM is a Windows utility that shows the amount of Expanded RAM installed in your system. It will also show you how much RAM is left for applications. Requires Windows.

DBWP is a dBase III to Word Per-

fect Mail Merge conversion program. It can be a real time saver.

TCKILL is a file deletion program with a twist. After files have been OK'ed for deletion TCKILL will toss them into the trash!

TETRIS is a wonderful game! This is the original version that was created in Russia. It is best described as an "action puzzle" and it will challenge your imagination and your reflexes for hours at a time.

TOGGLE is a useful little utility that lets you control the status of your keyboards NUMLOCK, CAPS LOCK and SCROLL LOCK keys from DOS.

STOPCLOCK is a handy little stopwatch that prints a huge digital display one your screen. Just the thing for the office olympics or for the occasional impromptu benchmark.

LIFE is a new version of a classic computer game. This one comes with complete on-line instructions and includes a detailed history of the game.

BUFFIT is a nice DOS buffer utility that lets you scroll through DOS screens that have disappeared from view.

ELTYPE is a simple typing test program for training and evaluating keyboard virtuosos. It provides real-time statistics on speed and accuracy.

\$19.95

VOLUME 34

DA is a multi-featured directory sorting utility that allows you to arrange DOS "dir" file listings in any order you please...program files at the top, data files at the bottom, yogurt on top, fruit on the bottom, you name it.

IAU is an invaluable hard-disk Interleave Adjustment Utility. It allows you to reset the "interleave" value of your disk, without disturbing your data. If your drive was set up by uncaring, unfeeling mechanics at the dealership, chances are you can double its response speed.

HDTEST is a very complete hard disk testing system. It writes and reads several types of test patterns on every sector of your drive, and will find subtle data weaknesses to faint for DOS to notice. Data is removed from suspect sectors, and the sectors marked as bad, soDOS will avoid them in future.

G uses a little data file to store "nicknames" for commonly-used directory paths. By running G followed by the nickname, you can immediately switch to the desired directory - no matter how distant it may be in terms of DOS path specs.

FLUSHOT is one of the most respected anti-viral protection systems ever devised. The program provides checksum protection of system files, immediate warning of any programs that try to leave portions of themselves behind in memory, and warnings any time a program attempts to do direct writing to your hard disk. There are numerous other options, plus very extensive documentation.

\$19.95

VOLUME 35

SCANNER is a goldmine of information for anyone interested in broadcasts you can't get on an AM/FM Walkman. **SCANNER** provides Canadian, American and world-wide (where applicable) frequencies for aviation, marine, NASA, news, weather, railroad, taxi and myriad other services.

BCALC41 is a Big **CALC**ulator which will delight anyone who requires miles of precision for their calculations. **BCALC41** can calculate pi (or any figure) up to 1075 digits with blinding speed, emulates a Hewlett-Packard calculator with numerous functions, ten memory and four stack registers, and is accompanied by its C source code.

CWCis is a remarkably thorough crossword puzzle designing tool whose output actually looks like a crossword puzzle, clues and all. Save and load your puzzles to disk, and edit or print them out at your leisure. Fair warning: the demo puzzle's a killer. Needs an Epson-compatible printer, but any video card will do.

FORMATQM is a practical ... and speedy ... solution to the nightmare of formatting an entire box of diskettes. **FORMATQM** easily handles all IBM PC and PS/2 disk formats. Though designed to format many disks in one sitting, it can format a lone 360K data disk in 41 seconds flat.

ANADISK is a comprehensive floppy disk aid which, among other things, will copy most disks **DISKCOPY** has problems with, allows editing of sectors or files in hexadecimal or text, and will endeavor to fix corrupted FATs and remap bad disk sectors. **ANADISK** reads most combinations of IBM disk formats, and can even read Atari ST 3.5" diskettes (this assumes you have an AT with a 3.5" drive) ...

UNERASER will resurrect accidentally erased files, providing they haven't been written over by other data. This small but vital program is extremely handy should you **DEL** one file too many.

\$19.95

VOLUME 36

FINANCE1 was written to keep track of the home chequing account, and allows both known and estimated (what if?) entries. Charts may optionally be generated of annual income and expenditures.

FORM275 uses IBM's graphics characters and comprehensive editing functions to make designing forms as easy as drawing them on the screen. It comes in handy for drawing street maps and decorative borders, too. Forms may be printed on printers which have the IBM graphics set in ROM, or saved for importing into database programs.

TELEPORT is a snazzy bit of

RAM-resident coding which enables you to capture, edit, merge and save up to four text windows simultaneously with a monochrome, CGA or EGA card.

ONside will take spreadsheets saved in ASCII format and print them sideways on an Epson-compatible printer. While that's not an original concept, **ONside** allows you to choose from seven inherent fonts which may be magnified in two directions. You may also elect to modify the available fonts or fashion your own. **ONside** can print lengthy sheets, and will use either a monochrome or colour video card.

WS161 actually isn't another WordStar upgrade, but an exercise in surviving in the wild. Find food and shelter in a forest that has little interest in your leaving it alive. CGA card required. Surprisingly addictive, it beats blasting acquaintances with paintballs anyway.

\$19.95

VOLUME 37

OPTIKS is a welcome solution to the amazing proliferation of varied ... and incompatible ... graphics formats vying to become the de facto standard. **OPTIKS** can read and

display .RLE, .GIF, .MAC, .PIC and a host of other graphics files. Once loaded, these files may be manipulated in every conceivable fashion. **OPTIKS** accepts images from some scanners, outputs to laser and dot-matrix printers and supports EMS memory, VGA, EGA, CGA and Hercules cards.

M2COM is a short program that turns readmac files into .COM files, thus eliminating the need for separate display programs. **M2COM** leaves the original readmac as is, and produces a .COM file of the same length.

GARFIELD is a fat, bug-eyed cat who, in this readmac graphic file, has no respect for computers. Aside from being cute, **GARFIELD** will give you something to read into **OPTIKS** and **M2COM**.

MAHJONG hails from Australia, though the game's roots are in China. Professionally implemented with three levels of play, its graphics alone will entice the uninitiated. Experienced players will appreciate never again losing a tile after a particularly frenzied game. Requires a colour graphics adaptor, though a colour monitor is optional.

PLAYLRN is a collection of learning games for toddlers 18 months to roughly four years old. Through use of sound and colour, future programmers are taught to recognise shapes, letters, numbers and simple words.

\$1995



VOLUME 38

CALENDAR is a perpetual calendar running from the middle of the sixteenth century up until way past the age of Star Trek. This program will show you when important dates fall in the years of your choice as well.

CPM2DOS will actually read files from the disks of most CPM systems onto your PC. Unlike commercial packages which purport to do the same thing, it includes a facility for creating custom formats. It's a perfect companion to **Z80MU** on Volume 11.

GCAP is the ultimate graphics screen capture. This resident utility will create GEM/IMG paint files from anything on your tube, suitable for use with Ventura, amongst others... an essential gadget for desktop publishing. Works with EGA monochrome, CGA and Herc cards.

MACSCOOP is an updated version of the popular MacPaint file reader and features support for Epson FX, Hewlett-Packard LaserJet+ and PostScript printers and for EGA, CGA and Hercules display cards. It will let you look at and print any MacPaint image file. We've included a few to get you started.

GEMSCOOP is very much like MacScoop, above, and has the same features for reading and printing GEM/IMG paint files. This is a really handy tool for desktop publishing.

MAC2IMG converts MacPaint to GEM/IMG paint files for use with Ventura, among others, allowing you to access megabytes of public domain clip art. Handy for use with **IMGCUT**, **GemScoop** and **Address** also in this collection.

MEMO drives a PostScript device to generate truly eye catching memos. It accepts raw text or WordStar files and prints them sophisticatedly.

FONTs is a collection of our favourite EGA font programs, which will reduce the screen characters of any EGA compatible display adapter. Included are Script, Computer, Future and others. Also included is **EGAFONT** allowing you to create your own font programs.

ADDRESS is a vastly enhanced resident envelope addressing program which allows for custom printer configurations and either standing text or graphics of your choosing for the return address.

VCHECK will do a CRC check of the sensitive system files on your hard drive each time you boot your machine, ensuring that none of them have been infected with viruses.

IMGCUT extracts fragments of GEM/IMG paint files for use with desktop publishing and other applications which use this image file format. You can pre-crop pictures to save disk space and time and can also make graphics files for **ADDRESS**, also in this collection.

PINPRESS prints text very, very small on an Epson FX-80 compatible printer and allows you to cram up to sixteen kilobytes of text in two columns on a single page and keep it readable.

SMALL is the PinPress for laser printers. This thing will print about four standard pages of text on a singler sheet of paper... rather small, of course. Works with any PostScript device.

\$19.95

VOLUME 39

BOOM is a program to display fireworks on your screen. You probably don't think you need one of these... most likely true, but it's fun to watch. Requires a CGA or EGA card.

COLORDIR is a very slick... and exceedingly fast... sorted directory program which uses screen colours to make large directory listings easier to out at a glance. A colour monitor, while by no means essential, is highly recommended.

DIGCLOCK is a huge screen clock which reads out in seven segment numerals. Easily read from across the room, or across the street with a good telescope.

DISPINFO is a C source file for programmers. It's a foolproof routine to allow your code to figure out what sort of video card is in the computer it's running on.

ED is another C source file, this one for the standard unix ed text editor. It has been reworked to compile under Turbo C, and will serve nicely as the basis for a word processor if you want to write your own.

EGA2RAM runs the BIOS of your EGA card from fast RAM rather than slow ROM. It speeds up your screen quite noticeably with no snow or other drawbacks. Requires an EGA card, ASM source code included.

FASTGIF is a GIF image file reader. GIF files are glorious colour picture files which must be seen to be really appreciated. We've included a GIF file of a mandrill so you can see what they're up to. Requires an EGA or VGA card.

HP-SLASH reduces the size of LaserJet soft fonts... and their resultant download time... by allowing you to selectively remove unused characters from them. This is an essential tool for anyone using a LaserJet compatible printer, especially with desktop publishing.

MAXI.EXE is the answer to every "insufficient disk space" message in creation. It formats up a normal double density floppy to hold four hundred and

twenty kilobytes, and a quad density disk to hold almost a megabyte and a half. Our tests indicated that these disks are no less reliable than normal floppies, and can be read in normal PC drives.

PC-POOL is a really well executed pool simulation. The ballistics of the balls is very nearly perfect, and the user interface is well thought out. It's not as gory as killing aliens, but it's better for your karma. Requires a CGA or EGA card.

REMINDER is a memory resident appointment calendar which pops up at the touch of an alternate key. It also features a screen clock which can be enabled or disabled at will.

RN is the best way to move around the subdirectories of a hard drive ever invented. Rather than having to type in complex paths, RN allows you to move around in menu driven comfort.

SAY is the best speech program we've encountered for the PC thus far. It's pretty intelligible, especially considering that it speaks through a speaker the size of a quarter connected to a timer chip. It comes with a host of phrases, including the all but essential "beam me up, Scotty". Good for disturbing your stupour in the morning.

VFM will warm the hearts of Ventura Publisher users. It allows you to add and reorganize fonts for this popular desktop publishing system without any sweat, bother or keying of batch files. No laser should be without one.

MCOPY is command line replacement for the DOS COPY command which allows you to copy files to floppies with maximum space efficiency, a prompt to swap floppies when the disk is full and full CRC checking to make sure that what you see is really what you get. DOS, as it turns out, doesn't verify its copies very well even with the verify flag on. This is an essential utility.

\$19.95

VOLUME 40

SQUYNCH is an adventure game created with the Adventure Game Toolkit. Charged by Squeeb II to retrieve his ruby, you'll face various unpleasant obstacles in fulfilling his request. **SQUYNCH** has a sophisti-

cated command parser which accepts complete sentences as valid input.

CRAPS is a realistic representation of the Las Vegas dice game. **CRAPS'** instructions include a thorough description of how the game is played and the odds of various bets paying off. You'll need a colour graphics card and ANSYS in your CONFIG.SYS file to play.

PICEM16D allows users of CGA, Hercules and EGA as well as VGA graphics cards to view multi-coloured .GIF, .PIC and .PCX graphic files. Plantronics and AT&T graphics cards are also supported.

ROGER.GIF is a multi-coloured graphic of Roger Rabbit, a cartoon hare of recent cinematic fame. Best viewed on a colour monitor.

EDMAC allows users to edit and (optionally save) readmac graphic files. Good for cleaning up the extra bits inherent in files ported from the Macintosh. **EDMAC** is accompanied by its Pascal source code, and requires a colour graphics card.

OPUS is a readmac of Berke Breathed's Bloom County character in a questionable state of Penguin Lust ...

FOWLPLAY attempts to settle the question of why did the chicken (or turkey) cross the road. Similar to Frogger, this game requires a colour graphics card.

ATALK is a number of humorous digitised sentences which actually sound reasonably clear through your speaker.

\$19.95

VOLUME 41

GALAXY24 is the latest version of the Galaxy word processor. Now equipped with a spelling checker, Galaxy allows the user to work on up to two textfiles at the same time and import text from one to the other. The colours Galaxy uses are user-selectable, and EGA owners may elect to display 43 lines of text instead of the standard 25. Galaxy can use the entire IBM character set, provides ten programmable macros to save you some typing, and will take advantage of a mouse, if you have one. Most popular printers are supported.

PC-TOUCH endeavours to improve your typing skills by recording your accuracy and words per minute as you type in the deep thoughts it throws at you from thinkers great and obscure. In executable form, **PC-TOUCH** comes with its BASIC source code, and allows you to change the quotes to virtually anything you'd like. **PHNWRD10** knows that you've always wanted to know what your phone number spells out, and is willing to display ... or print ... all 2,187 permutations to help you out. Few of these will actually make sense, but there may be an interesting phrase or three nestled in amongst the resultant cryptograms.

\$19.95

VOLUME 42

FORMATQM is a very, very fast disk formatting program.

FIREWORK blanks the screen after a period of inactivity and shows you fireworks until you do something. Windows is required.

SNAKE is simply the best snake game every written.

BELL makes the sound of the beep in your computer slick and sophisticated.

CALLTIME will dial up the atomic clock in Ottawa and set your system clock accordingly. A Hayes compatible modem is required.

CASE will change a text file to all upper or all lower case, strip of the WordStar bits and do other useful things.

CDTO provides a simple way to locate files in other subdirectories and the go to their locations.

CLOCK is the biggest resident screen clock in creation.

DDATE is a cursor driven date setup program.

DEV shows you where all the device drivers in your system are.

KTIMER times the execution of any program to the nearest 100th of a second.

LISTFRAG shows you how fragmented your hard drive is, allowing you to decide whether it's worth running a defragmenter program.

MAPMEM let's you see what's where in the memory of your system.

NREFRESH slows down the refresh rate of your system memory to increase the speed of your machine.

RAMVIEW is a resident program that lets you pop into a hex and ASCII dump of your system and page through your RAM. Very revealing.

REPEATS locates identical files in a complex hard drive system, allowing you to free up disk space.

SETALARM wakes you up at a predetermined time.

SILENCE more or less totally kills the speaker of your PC.

STEPDOS allows you to step through the execution of a program one DOS call at a time, with an informative display at each pause.

VTREE2 shows you a map of your system and the sizes of your subdirectories. Great for pruning.

WATZITDO returns information about the multifarious alternate key combinations on the PC.

WF is a very clever wild card find program that searches for files on your hard drive without asterisks or question marks.

WORLDTIM lets you see the time anywhere in the world.

WPHD disables writing to your hard drive temporarily, protecting it from viruses to some extent.

XPANDISK creates a very sophisticated, variable sized RAM disk in expanded memory.

TUNEUP uses your PC's speaker to generate extremely precise pitches for tuning stringed instruments.

FORM generates business forms.

TCAP captures text screens, but makes them into GEM/IMG files

\$19.95

VOLUME 43

MAGMA is a truly weird graphic arcade cum adventure game. Tunnel through the depths of the earth, contact spies and try to assemble all the fragments of your secret document.

BANKER will keep your check-book in balance... as well as anything short of divine intervention can.

FONTFILTER adds special effects to LaserJet softfonts... and does it brilliantly. Included are such effects as drop shadows, enclosing boxes and even blood dripping from each character... Also includes the complete C source code.

READRITE is a real time readability analyzer. A resident program, you can pop it up from within your favourite word processor and get a readability index for the contents of your screen. Very slick.

CALC is the nicest pop up programmer's calculator we've encountered... and it's great for anyone else who has to deal with numbers too. It includes base conversion and other useful functions.

CARDFILE is a little pop up data base program which will keep track of people, places, phone numbers... it even dials your phone through a Hayes compatible modem.

RECORDER will keep track of the frequency of access of the files you use to help you decide how best to use a RAM disk.

BARMENUS compiles and implements Lotus style menus in applications other than Lotus. It's a great toy for die hard 1-2-3 users, and not a bad user interface for the rest of the planet.

SNIPPER is the slickest text cut and paste program we've encountered to date. Copy text from the screen of just about any application into just about any other one. Great for getting spreadsheets into your word processing documents.

SWEEP will execute any command you like in every sub directory of your hard drive.

CONFIG is splendid. It lets you alter the way your CONFIG.SYS file is interpreted by DOS when your system boots up. You can exclude specific drivers at boot up time to free up memory space... no PC should be without it.

Z80XASM has been requested by a number of our users. It's an assembler which runs on a PC compatible system but assembles ASM source code for the Z80 microprocessor. Includes a Z80 machine language monitor as a test file.

HERCSAVE is the most reliable Hercules screen blanker we've come across. Save those green screens.

FSEE is a quick and nasty way to see what LaserJet fonts look like without having to download them to a laser printer... it shows them on the screen of your PC in graphics mode. Handy for use with FONTFILTER, above.

OKSCR is a really elegant way to get reliable screen captures from graphics applications. More to the point, it actually works. Writes to PC Paintbrush compatible files.

VALSPEAK translates English into valley girl talk. Gag me with a spoon.

TED is a very small text editor... two

kilobytes is very small. It's about the easiest little editor in creation for just whipping up a few lines of a batch file or changing a driver in your CONFIG.SYS file. It's also good for program editing.

EGALINES is a collection of tiny utilities which will set your EGA card to different line sizes so you can see what text looks like in the higher resolution modes. Includes 12, 25, 35, 43 and 50 line modes.

EGAITAL puts your EGA screen in italics mode. Not blindingly useful, but it's only about a hundred bytes long.

PCXSCOOP is a file reader and printer for PC Paintbrush PCX and PCC files. Let's you check 'em out without loading the whole ZSoft circus. Handy for use with OKSCR, above.

\$19.95

VOLUME 44

BCOPY is one of the cleverest copying programs around. It hides in the background while it's working, so that immediately after issuing a copy command your DOS prompt returns and you're ready for whatever's next. A great little time saver.

BDS is a slick pop up electronic engineer's calculator. It handles things like wavelength, capacitance, radio equations and so on.

CALCQF analyzes your system and figures out how much you can speed things up by changing the refresh rate of your memory without crashing your machine. Then it generates a small COM file to include in your AUTOEXEC file.

JIVE translates any English text into jive.

LUM is a sophisticated sideways printing program which is great for spreadsheets or any application wherein regular paper just isn't wide enough. It supports multiple fonts, effects and so on. Requires an Epson FX-80 compatible printer.

NJFRERAM will show you how much free memory you have from moment to moment up in the upper right corner of your screen. Great for spreadsheet users, amongst others.

ORDER changes the order in which files come off your disk when you type DIR. This allows you to pre-sort your directories, or adjust them in any order you like to make frequently used programs boot more rapidly.

PYRO we've had fireworks programs before... but this is the best. It does EGA fireworks, complete with sound effects, and is truly glorious. Includes C language source code. EGA/VGA card required.

SOT is the son of Tetris, the addictive game from the Soviet Union. This one is even more devious.

STYLIST is an essential tool for any Ventura Publisher user. It allows you to edit, manipulate and print out any style sheet.

TONTO is a SideKick-like program with a host of features, including a clock/calendar for any year since the middle of the sixteenth century, an ASCII chart and a printer setup program.

MR BOSTON is the ultimate bartender. It holds recipes and complete



directions for zillions of mixed drinks... from the common to the delightfully bizarre... and provides you with an outstanding user friendly program to access and even add to the list.

\$19.95

VOLUME 45

POPDOS2 is a pop up DOS shell. You can rename, delete, type and generally meddle with files from within any application. It can save your life when your disk is full and your file hasn't been saved.

CALLFOR is a resident equivalent of those pink message slips that proliferate around offices... just the thing for an overworked receptionist, especially one with bad hand writing. It can be popped up from within a word processor or other application when the phone rings.

CLEARCUT will scan your word processing files and suggest places wherein you've used more complicated wordings than you should have. It helps to simplify your writing and make it easier to read.

CONFMT is a resident disk formatter. It allows you to format floppy disks as a background task while you run normal programs. It's quite a time saver.

FLEES is like Space Invaders on acid. It's blindingly fast, with brilliant graphics and some really bizarre aspects. Requires an EGA or VGA card.

PALMEGA is a computerized palm analysis program. Better than an old lady with a crystal ball, it will tell you how

long you'll live, how rich you'll get and whether or not you'll meet a tall, dark stranger who'll try to sell you swamp land in Florida. EGA or VGA card required.

P4UP will print four pages of normal text on a single sheet of paper on most laser and inkjet printers. It has a number of sophisticated formatting features, too.

SHFTPICK is ideal for people with a lot of resident programs on their hard drives. It allows you to hold down the Alt key and bypass loading them when your system boots up.

MDIAL is a memory resident dialer program and phone number data base. Connected to a modem, it allows you to dial voice calls without actually touching a phone.

SMOOTH is the leading edge of text browsing programs. It will smooth scroll back and forth through any text file. This may seem like overkill... well, it is, actually... but it's awfully neat to watch.

VALET is the best DOS shell program we've encountered. It will move, mass copy, delete, rename and generally handle the files on your hard drive in menu driven comfort. It's ideal if you don't like typing in commands.

WIPE totally destroys files on your disk so that they can never, never be restored and looked at again. It's an essential tool if you deal with sensitive data.

YEARCAL creates calendars for any month of any year of the twentieth century. However, it creates more sorts of calendars than you can possibly imagine... in sixteen languages, including Texan.

S O F T W A R E F O R T H E P C

SUPERDISK SOFTWARE

SUPERDISK 1

EBL This is the latest version of the Extended Batch Language, an easy-to-use program that lets you customize hard disk and floppy disk systems for less experienced users. Create custom menus and make your system idiot-proof — without the need for a complicated DOS shell program.

TIRED You may want to save this one for April 1st. Sneak it into a friend's BATCH file, or run it from DOS (while your friend is at the coffee urn). Spectacular, but harmless results.

BREAKON Ever need to exit from a program in a hurry? Or do you get frustrated when your computer hangs up because of a software problem. You could press the RESET button, or try running BREAKON. This little beauty works with many popular programs.

PKARC If you want to keep archive copies of important, but rarely needed data files or programs, an archiving program is an inexpensive alternative to buying more floppy disks. Archive files with PKARC and extract them with PKXARC. These utilities are fast, accurate and they'll help save on disks.

DSIZ DSIZ is a utility that will provide information on the size of the various directories on a hard disk system.

CONVER An easy-to-use unit conversion utility. This provides imperial, metric and U.S. conversions for all common units of measurement — and many uncommon ones as well. Provides well over 200 conversions.

CUTE TIME Friendlier than a clock program, but not as accurate, running QT gives on an English approximation of the time. "It's about half past two", for example.

DRAIN Another April Fool's program. Run DRAIN to remove the water from your disk drive. Keep 'em rolling in the aisles.

XEQ This utility is designed to let you manage those small but useful programs that tend to clutter up disks. Files can be added, removed and run from XEQ.

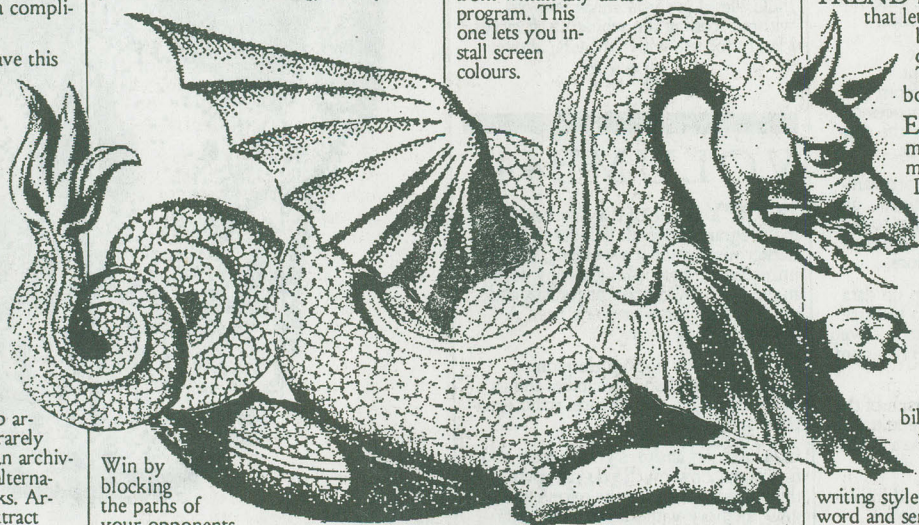
ORDER Use ORDER to change the order in which files appear in the directory on your disks. This utility will create order out of chaos in large directories. Great for hard disks.

TSR For SideKick, ProKey and SuperKey users — or anyone who uses co-resident software. This utility lets you remove co-resident programs (such as those mentioned above) from memory — without rebooting your computer!

\$19.95

SUPERDISK 2

BLOCKADE Play with up to two human and five computer players. This territorial game will generate hours of excitement. This version lets you select a number of game parameters such as strategy and speed.



Win by blocking the paths of your opponents in order to gain territory.

DALEKS A game of skill and logic based on the Dr. Who television series. Use your talents to rid the universe of the dreaded Daleks.

RLOGIC Save the world from nuclear annihilation. This one is trickier than you might expect.

CAVERNS OF GINK A strange name for a strange game. Explore the Caverns and see what you'll find.

LETFALL A great way to learn touch typing and have fun too. This one lets you work on tricky key combinations and reports on your progress.

WIMPS Maneuver your spaceship and blast away at marauding wimps. A great zero gravity simulation.

FLIGHTMARE As an Omega jet fighter ace, your job is to protect your factories from dessert hordes.

PYRAMID Hop on each triangle in the pyramid and score points, but watch out for the snakes!

HI Just run Hi from DOS or from within a BATCH file and be prepared for a daily dose of inspired wit and wisdom. From Confucius to Murphy, this program has it all.

\$19.95

SUPERDISK 3

DSCAR This is the "dBase Source Code Analyzer and Reporter", a utility

that lets you pretty up and document your dBase programs. This program is very flexible in analyzing your files. You can even edit the reserved word list so that it will work with future updates of dBase III as well as with dBase compilers such as Nantucket's Clipper.

SET COLOUR A simple, but well written routine that can be called from within any dBase program. This one lets you install screen colours.

DB-CHECK Check the logical flow of your dBase programs and have this handy utility indent your programs so that they are more easily read and debugged. This one is fast!

FLOW A quick program flow checker that matches up DO's and END-DO's, IF's and ENDIF's and DO CASE's and ENDCASE's. It makes those hard to find errors easy to find.

DB3TOPAS Not an everyday utility, DB3TOPAS creates Turbo Pascal routines that can access dBase III files.

LBARGEN This is a simple dBase III Light Bar menu generator. Just enter the options for your application and LBARGEN will generate a .PRG file, saving you the time and energy required to do it yourself.

DL1B This is a shareware Clipper library which can be linked with any Clipper program. There are all sorts of great routines in this one — everything from screen handling functions to financial formulae and a phone dialer for modem users. A powerful addition for all dBase/Clipper programmers.

BEEPER Another Clipper utility. Assemble with MASM and link BEEPER with any Clipper program and you'll gain control over the PC's speaker. Alter pitch and duration and add sound to your programs.

HELP There are many good books on how to use dBASE III, but these 7 text files provide dozens of "power user" tips that are often overlooked. These files contain a host of information on using dBase with Lotus 123, backing up large data files, printing, indexing and generating labels. Just use

the DOS TYPE command or any ASCII word processor to read the files.

\$19.95

SUPERDISK 4

TREND is an easy-to-use program that lets you make projections based on past historical data which the user enters. The program can display both line and bar-graphs.

EE2 is a handy "Environment Editor" that lets you make quick changes to DOS PATH and SET commands. The few simple commands needed to run this utility are explained in a small help screen. Requires DOS 3.1 or higher.

PCSTYLE A public domain program which tests your prose and provides a quick test for readability. While not a substitute for a competent English teacher, PCSTYLE can help you improve your

writing style by providing statistics on word and sentence length, percentage of action verbs, etc.

PLANIT is an interesting appointment reminder program. By keeping all of your important dates in a text file (created with your word processor), PLANIT will check the file and tell you if you have any important engagements. A host of options enable you to set up messages which repeat weekly, monthly and yearly. It even warns you of important dates before they arrive!

CPU2 is a speed checker/benchmark program. It measures the speed of your IBM PC compatible system against a standard IBM XT configuration. The assembly language source code is included, so you can see how it's done.

EXPENDIT is good expenditure tracking program. Designed primarily for personal use, EXPENDIT lets you set up various categories for your monthly expenses to help you see where all the money goes. A variety of printed reports can also be generated.

MAKEREAD is a simple, and somewhat strange utility that converts text files into programs. When one of these programs is run, it prints the text contained in it on your screen. An odd program, but it could be useful for generating help short messages for inexperienced users.

REMINDER is a good on-screen clock/reminder utility. Press ALT-R to see the time. You can also enter daily appointments and REMINDER will chime when the time is at hand.

FORTUNE is a complete text simulation of one of TV's most popular game shows. All that's missing is Vanna and the commercials.

FIRE is a great little game which

simulates a forest fire. You devise complex strategies using water bombers, etc. in order to quench the flames.

BLORTII is a fast-paced colour graphics game. You have to be quick with this one!

\$19.95

SUPERDISK 5

DR.COM Need to look at a file, or copy it - fast! Call the DRI. **DR.COM** is a small assembly language program that lets you quickly call up the files in a directory. You can display files in order by name, date or size. Files can be viewed, copied, renamed, or deleted with a little help from the DR.

SIMCGA is the newest version of an indispensable utility for users with Hercules-type graphics cards. This one lets you flip back and forth between Hercules and Colour Graphics programs with two tiny utilities which can be run from DOS or Batch files. Yes, you can run CGA games with your Hercules card!

DATASCAN is a shareware program which is designed to give scientists, statisticians and business users a quick overview of the relationships between the variables in their data. When you load a data file, **DATASCAN** plots an array of small scatter-graphs, showing the various relationships of up to nine variables. The user can "zoom in" on any graph for more detailed information. You can extract a variety of statistical information such as correlation coefficients, and plot linear regression lines. **DATASCAN** is not intended to replace any of the more powerful statistical programs such as SAS, but it is powerful enough to enable you to detect statistical correlations within your data. This will pace the way for more indepth study. Requires a Colour Graphics Display. **DATASCAN** also works with EGA displays and Hercules compatible graphics cards using the **SIMCGA** utility included on this disk. Graphs can be printed on most dot-matrix printers if **GRAPHICS.COM** or replace graphics driver has been loaded. **DATASCAN** works with Lotus 1-2-3 .PRN files, or you can enter data direct.

ZENCALC is a small but powerful spreadsheet program which performs many of the mathematical operations available with commercial spreadsheets. Extensive on-line help is available by pressing the "?" key. **ZENCALC** is perfect for fast number-crunching.

PC-FLOW Flowcharting as a planning tool is often under used, simply because the use of templates can be very tedious. **PC-FLOW** is a flow chart designing program which makes flow-charting easy and fast. **PC-FLOW** lets you manipulate a variety of symbols and lines using either a mouse or the keyboard. Requires a color graphics card. A special file has been included that will let you **PC-FLOW** with a Mouse Systems Mouse.

\$19.95

SUPERDISK 6

YAHTZEE This is a great version of a classic game. Pit your wits against several other players, including the computer. Keeps track of high scores and has a good on-line help screen.

MAROONED — High adventure in space. Your ship has crashed on an alien planet and you must escape.



BLACKJACK — Lots of excitement and nothing to lose, this game plays a strong, but honest hand. Learn the strategy behind this diversion.

MAYAKDM2 is an enlightening text (with ASCII graphics) adventure game. You need a creative soul and a searching intelligence to escape the materialistic — and deadly — Mayan Kingdom. But greater and more meaningful pleasures can be yours if you can cross the ocean to freedom.

3DTICTAC Just like the name says, this is a 3-dimensional Tic-Tac-Toe game. And a mean game it is too! Just you and your computer in an all out battle of wits.

ICBM Save a city from nuclear annihilation. Blast those ICBM's before they blast you. Requires a colour graphics (CGA) card or equivalent.

CRSWRD is nice little program which lets you create your own crossword puzzles. It lets you enter words and clues, edit them, save them — and print them.

ROBOT is a clever game of strategy in which you maneuver a small creature around the computer screen. A number of robots will try to attack you. If the converge on you, the game ends. With careful maneuvering, you can cause the robots to destroy each other. There is also a teleport key — just to add a little more excitement.

\$19.95

SUPERDISK 7

ASTRO is an astronomy simulation program which graphically demon-

strates planetary motion around the sun. It also performs a number of calculations such as lunar phases, sunrise and sunset times. Requires an EGA display.

TOFHANOI This is a nice implementation of a classic logic problem. The object of the game is to move a tower of disks from one platform to another. But you can't place larger disks on top of smaller disks. Requires an EGA display and a logical mind.

TICK is a classic Space Invaders-type game - with a frightening twist. Maneuver a tank at the bottom of your screen and try to eliminate the giant bugs that are trying to get you. Requires a CGA display and fast reflexes.

SOPWITH2 lets you battle the Red Baron in a vintage World War I airplane. The program has realistic flight simulation - it will even stall and crash if you fly too high or too slowly. Requires a CGA display.

GOMOKU is an easy game to play, but a difficult game to win. Enter coordinates from the keyboard to place an X on the screen and try to place 5 Xs in a row. The computer will try to stop you - and you must use your wits to keep the computer from winning.

FOOTBALL is an nice NFL football simulation. It is very complete, allows you to choose any two teams you like and even includes details such as a coin toss to see which side kicks off.

HIQ is brilliant computerized version of a classic peg-jumping game. On a cross-shaped board you try to eliminate all of the "checker pieces" by jumping over them. The object is to clear all but one piece from the board. No special hardware requirements.

KILLER is a well-executed graphics-game that lets you shoot down the "killer bees". Requires a CGA display.

\$19.95

SUPERDISK 8

HAVE is a nice little system information utility that will provide you with information such as the number of installed serial ports, parallel ports, type of graphics adapter, number of floppy and hard drives and amount of memory. **HAVE** even draws a picture of your computer with extended ASCII characters, complete with printer, monitor and keyboard. Its a nice touch.

HANDLES is a small utility that shows you how many files DOS will allow open at the same time. The assembly source code is included to in case you want to see how it is run.

WCD is a nice little program that calculates flying times between world cities. Select any two international airports and you get a display showing their longitudes and latitudes and an estimated flying time. Distances in Miles and Kilometres are also shown. Handy for frequent flyers.

HLPURSLF is a resident help screen system. A series of HLP and MNU files are included to help you set up your own custom Help system. A great way to help new users learn about their computers.

UNIX has absolutely nothing to do

with the operating system of the same name. This **UNIX** is a fast and furious pinball game. It does a great simulation of the real thing. Saves on quarters too.

VDE is a small full-screen text editor that could make a great programming editor. It's also good for "quick and dirty" text editing for BATCH files, etc. It only needs 11K of RAM, but it still boasts WordStar compatible commands and comes with an installation program to it can be customized for your own needs.

EP is a PATH editor which lets you quickly add or remove paths from your PATH statement. Small and fast, EP's program screen incorporates a complete list of editing commands to make altering your PATH statement quick and easy.

TAO is, well TAO just is, that's all. Based on the TAO of Programming, this program displays a random gem of wisdom from the Master Programmer every time you run it. More food for your AUTOEXEC file.

\$19.95

SUPERDISK 9

TAX87ONT is a comprehensive Lotus worksheet (version 1.X) for Ontario tax returns (unfortunately, we could not locate a similar worksheet for other provinces). **TAX87ONT** is an elegant worksheet which even includes all tax schedules. A split screen window lets you see whether you owe tax or vice versa. It's simple and easy to use.

BANKRUPT is a good worksheet for investors and potential investors. It lets you calculate the likelihood of a publicly traded corporation going bankrupt using "The Bankruptcy Predictor Formula", a formula was devised by Edward I. Altman, a financial economist at New York University's Graduate School of Business.

LOTUSX is proof that computers have been taken over by practical jokers. Run **LOTUSX** and an innocent looking worksheet is displayed. Press any key and the worksheet will actually "crumble" before your eyes! Slip it into a colleagues AUTOEXEC.BAT file.

HANGMAN is a competent version of the Hangman word game written as a 1-2-3 worksheet! It comes complete with simple ASCII graphics.

OIL is a simple worksheet which forecasts oil prices from a number of historical factors.

123LEARN is a menu-driven macro creation worksheet. Using Version 2.00 or higher, you can use 123LEARN to record keystrokes in order to create complex macros.

CHKBKC2 is a personal finance management worksheet which lets you balance monthly income and expenditures. Customize it to suit your specific needs.

TMPDOOM is a series of mystery adventure games created as a series of 1-2-3 worksheets. Solve the mysteries by using your skill with Lotus commands. A great teaching tool.

\$19.95

LEISURE LIBRARY

VOLUME 1
COLOUR CARD
PROGRAMS

AQUARIUM make your monitor a fish tank which cannot spill onto your computer. Good for endless hours of meditation. CGA is required.

MSLIFE or more fully, the game of life for Microsoft Windows. A mouse is almost vital for setting up screens. This version has some nice features, including constant update of the MSLIFE icon.

AIRPLANE allows one to display and print blueprints for paper airplanes. Great for office mayhem. CGA and BASICA or GWBASIC are required.

SIMCGA version 4.0, the latest we've found. As with earlier SIMCGA's, this is simple to use. It supports all three CGA modes, normal, forty column, and hi-res mono mode. All the CGA programs on this disk worked for us with SIMCGA.

HELPME cannot be described. If it does not startle, perhaps even scare people around you, find some people to show it to. Run it and listen to what happens!

SAYTIME basically just says the time. This is a resident program which will cause your system to speak the current time whenever the correct key code is entered, even when you are in another application. Great if you can't see a clock and your screen is too full for an on screen one.

CALLTIME should only be used by Torontonians. It calls Toronto's own radium clock, and grabs the time correct to the second, then installs it on your system. If you have an AT, it even installs it in the battery supported CMOS. Requires a modem connected to an outside line which can call central Toronto without long distance fees. Version 3.1.

PLANETS computes information relating to the position, distance, magnitude, and so on for the major planets in our solar system on a specific date and time. A must for space travellers. CGA required for graphic displays.

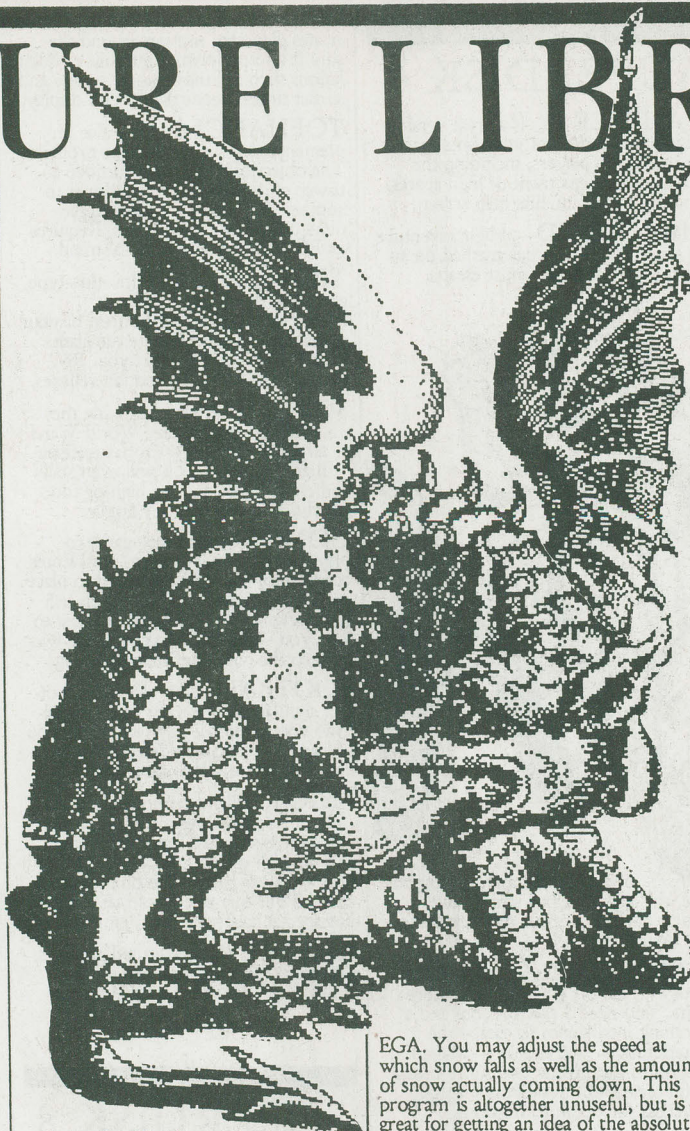
MELT clears your screen slowly. Sort of. This is the type of program which makes DOS's CLS command so ghastly boring. CGA is required.

DAZE This too, is a little weird. An excellent way to leave an unused computer, this colour demonstration leaves accounts receivables in the dust! CGA required.

WHIZ cleans the inner surface of your monitor with electron brushes already available to users who have CGA compatible systems. Great for that one glaring hard to get at place.

JOYCAL is a slick joystick calibration system specially designed for those with...you guessed it...joysticks. It will support both joysticks simultaneously, calculate the centre, then tell you how to adjust your stick.

DRSLEEP, Dr. Sleepite and the Nightmare Factory is a strange ex-



perience. Get fifty thousand volts through your body, be attacked by killer pillows, and above all, avoid sleep. The mad doctor is at it again. This game requires CGA.

\$19.95

VOLUME 2
EGA PROGRAMS

MONALISA is the lady herself. The picture is drawn slowly but accurately. EGA required.

EGAD is one of the most impressive EGA demonstrations around. It has everything from flickering photos to QIX lines to a multi-shape kaleidoscope in full colour. Supports mice and exploding boxes.

EGAWAL creates complex geometric patterns on EGA the screen. Run this and stand back and watch! Another great one for bored machines.

ROSES creates similar EGA patterns to EGAWAL, however, it creates them faster and makes them look more like flowers. The originality of program names is astounding, no?

EGASNO simulates a snowfall in

EGA. You may adjust the speed at which snow falls as well as the amount of snow actually coming down. This program is altogether unuseful, but is great for getting an idea of the absolute limits of EGA's resolution.

MGGS stands for Mandelbrot Graphics Generation System. This gem of a set of programs calculates Mandelbrot images and displays them on either CGA or EGA systems. Calculations may be done with a math co-processor if you have one installed. Version 3.2.

FRACLAND draws landscapes, shorelines and islands shaped by fractal geometry. Interesting, realistic, and BASIC source code is even included. CGA is required.

AUTUMN displays autumn colours and leaf-pile designs which are also created using fractal geometry. Source code is unavailable. CGA required.

TEAPOT is an EGA demonstration of three dimensional graphic rotation abilities. Use the cursor pad to decide which direction and on which axis your teapot will spin and from where you will observe it.

ROLEX is a giant screen sized EGA watch face which keeps accurate time, assuming your system clock keeps accurate time. Also includes the date as an added bonus. This program could be useful in offices where spare computers outnumbered spare clocks.

LINEs is a collection of commands to determine how many lines your screen

will keep in EGA. Select 15, 25, 35, 43, 50, or 60. Also included is a command to give you 120 columns. Works only with EGA.

EGA2RAM takes IBM EGA BIOS and stores it in RAM, then tells the computer to refer to the RAM copy of the BIOS instead of the ROM. This speeds up many EGA screen writes, since RAM is much faster than ROM. Assembler source is included.

ATI2RAM is the same sort of thing as EGA2RAM, but it works with ATT's EGA Wonder BIOS instead of IBM EGA. Speed increases can be anywhere from fifty to one hundred percent, depending on whether the software makes direct memory writes or actually uses BIOS.

\$19.95

VOLUME 3
GRAFICS & GAMES

EGA2GIF is a memory resident utility which grabs EGA screens when you hit the key combination, and stores them on disk.

VGIF, a GIF picture viewer in EGA, can also convert GIF pictures to formats used by various paint programs, including EGAPaint, PC Paintbrush, etc. Also allows for slide shows of pictures. Included are three GIF pictures to start your own slide show.

XONIX is a fast paced game of luck and mental coordination. This is perhaps one of the most addictive games around. CGA required.

ALDO is a game which was created specifically for AT286 machines with 256K EGA cards inside 'em. It's basically a Donkey Kong clone, with really smooth graphics.

DALEKS will be a natural to all Dr. Who fans. The object of the game is simple...smash as many of the robots as you possibly can before getting killed.

PITFALL is a simple but fun exercise in futility. You are dodging the walls of a pit as you fall deeper and deeper. Trouble is, the pit gets narrower as you go.

MUMMIES is a simple low resolution game which is actually quite similar to DALEKS. While exploring the tomb of the ancient King Mut, you are set upon by hordes of mummies. Wonderful topic for a computer game, and it's fun.

SCRABBLE is Scrabble. This one is in EGA, knows all the rules, and even keeps score for you. Definitely a classic computer game, even if it can't play against you.

CHESS is a very small chess player, rather fast, not impossible to beat. CGA is used, and the pieces are made of not wood or metal, but realistic graphics. Small enough to fit in a pocket, it's just the thing to while the time away when you should be word processing.

\$19.95

CLIPART

FOR PC/XT/AT AND MACINTOSH

Digital ClipArt is the spice of desktop publishing. However, unless you have a scanner and a ready source of hard copy clipart at your disposal, you'll have a hard time amassing a library of images. At least, it used to be.

Almost Free Ventura ClipArt picture collections are disks full of image files. Each disk has a variety of pictures, both for spot illustrations and full pages. They're suitable for reproduction on any output

device. Almost free clip art now supports Ventura Publisher, Aldus PageMaker and WordPerfect 5. In fact, it is compatible with almost all desktop publishing packages, paint programs and word processors which accept graphic files. Each disk comes with a utility to convert the clipart to MacPaint, GEM/IMG, PC Paintbrush PCX and PCC, and TIFF file formats, suitable for use with a wide variety of applications. Only \$19.95 each.

VOLUME 1

BABY, BELVEDERE,
BLUES BROTHERS, BLUENUN,
BUGS, CHEETAH, CLIPART,
FISHES, GIRLWING, KNOT,
KOALA, LETTER A,
HEARTS, WOMAN,
RELATIVITY, SCAN
ESCHER WATERFALL

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AIRCRAFT, BUTTERFLY,
CAR LOGOS, MORE CLIP ART,
COLLECTORS CARS, CUBE,
DANCERS, DRAGON, GLASSES,
GREYHOUND, HANDS,
MORE KNOTS, SKELETON,
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MEN2, WOMEN2,
PERSUIT, SUNDIAL,
PORCHE, EASTWOOD,
VANGOGH, IBMWARS
STELLA, QUADRANT,
YAWN

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CLIPART1, CLIPART2,
CONAN6, COUPLES4,
DRAGONX, ELEGANT,
HUNTED, KIDS3,
KRAZYCAT, MEN3,
SCRAPS, SCROOGE,
SPLINTR, WOMEN3

VOLUME 6

AUSTRAL, CLIPART3,
CLIPART4, CONAN1,
CORNCOCK, DONATELL,
IBMGIRL, KIDS4,
MEN4, NEWMACS,
PANEL, PINUP,
POOH, SPORTS,
WOMEN4

VOLUME 7

ANBORD2, BIGBEN,
BORDER4, CIVWAR,
DRUIDESS, FISH,
GARDENWA, GIRL12,
INSECTS, LIONCUB,
MINTPLAN, NATURE,
PIE, RUINS, WEAVING,
WMAP, MISC1

VOLUME 8

ANTBORD, BERRIES,
BORDER1, CUTOUT2,
DOG, EAGLEBOR,
FLWALL, HORSE, INDIAN,
JACKIESC, JAGUAR,
KNIGHT, MACRAT,
OWL1, PITCHER, PIZZA,
STUFF2, HKGIRL



NEW!

T W A R E F O R T H E P C

COLOUR CLIPART



VOLUME ONE — GIF® IMAGES

If you have an EGA or VGA card in your system, you only think you've seen computer graphics until you've seen these pictures. Even if you're stuck with a lowly Hercules board, these files are pretty exciting.

The GIF format allows for all the resolution your computer can handle... some of these pictures have two hundred and fifty six colours and sufficient detail to make them all but indistinguishable from photographs. The result... seen in the crisp, luminous colours of a computer monitor... is wholly stunning. If you buy this collection and do nothing more than just look at the pictures, we're certain you'll consider it money well spent.

We've included viewer programs for these files to really do them justice.

These files can actually be used for something once you've finished being blown away by them, however. If you convert them to PC Paintbrush format, you can pour them into Ventura chapters and use them as desktop publishing clip art... admittedly, in less than exciting black and white unless you have a colour output device. We've included a program which will convert most of them to either PCX or RIX colour format. However, we strongly urge you to buy a copy of TGL Plus, a commercial file conversion package which will allow you to manipulate them in much more useful ways, and get them into virtually any file format you like. See the December 1988 edition of Computing Now for more information about TGL Plus.

Because of the size of these files, we're distributing them on a single quad density disk. You will need a 1.2 megabyte AT drive to read it. If you can't get this together, you can order this collection on four normal PC type disks for a slightly higher cost. (Sorry about the up charge... it's for the duplication time.)

The colour images in this catalog are fragments of some of the files in this collection... although they lose a great deal in the printing process.

DRAGNLDY This is the most amazing computer graphic you'll probably ever see, as well as being a fabulous piece of art. It's a lady and her pet... and her tattoo. (Note that this file is too large to fit on a single 360K floppy. If you buy the 360K disk set, we'll include a 50% scaled version of it.)

VARGA One of the original paintings by Varga, a lady and a phone. A portion of this image is reproduced below.

BABOON A colourful mandril.

BLADERUN From the film Blade Runner.

BODE1 A seductive little wench from the pen of the late Vaughn Bode.

DESTRO The Star Wars star destroyer.

DOLPHIN A painting of two dolphins.

DRGN A pretty evil looking dragon.

FRUIT A still life in phosphor.

KINGTUT The death mask of the boy king, the face that launched a million T shirts and coffee mugs.

LIGHTS Night time.

MONKEY A photographic quality reproduction of a Rhesus monkey.

MOUSE A mouse... again, in amazing resolution.

OPTIC1 An optical illusion.

PEPPER A digitized album cover.

SHORTS A girl in cut off Levi's. Honest... they made me do it.

STEPH A girl in a T shirt.

TALLSHIP A dipper ship.

TURNER1 A painting by Turner.

TURNER2 Another painting by Turner. Both of these are pretty nearly photographs.

UANGEL An angel and a unicorn.

\$19.95 (Quad disk version)

\$31.95 (Four 360K disk set)

VOLUME TWO PCPAINIBRUSH® COMPATIBLE

If you like the idea of full colour images to play with but you don't really have the hardware to make our GIF collections worth while, you might want to check out this assortment of picture files. We've selected some of the best sixteen colour images from our voluminous colour clip art collection, converted them to the PC Paintbrush format and assembled them into this assortment.

These pictures are compatible with Ventura publisher, and when you get finished looking at them you can pour them into desktop publishing chapters if you want to. Once again, we strongly recommend that you buy a copy of TGL Plus, as described above, which will allow you to convert these pictures into almost any graphics file format you need.

These files are kind of big... this collection requires two regular 360K floppies to hold it. Also note that some versions of PC Paintbrush do odd things to palettes... some of the colours may require fine tuning for your system.

PUMA A mountain lion in the wild.

ASIA A lady from the far east.

BABOON A very colourful mandril.

BLADERUN From the film.

BODE1 Vaughn Bode's smiling wench.

DESTRO The star destroyer.

DRGN A pretty fierce looking dragon.

ESCHER A reflection in a mirrored ball.

FRUIT A still life in phosphor.

KINGTUT The boy king's death mask.

OPTIC1 Just an illusion.

TALLSHIP A splendid clipper ship.

WINEGLAS Three champagne flutes.

WIZZARD From the film.

\$25.95

(Two disk set)

LASERJET FONTS VOLUME 1

If you use Ventura Publisher or any application which drives a Hewlett Packard LaserJet Plus compatible printer, you will certainly have experienced the lack of interesting fonts available with most commercial programs. Desktop publishing is really a bore if you can't drag yourself out of the usual mire of Times and Helvetica and sing once in a while.

Now you can. Almost Free LaserJet soft fonts are collections of decorative headline faces to dress up your documents. They can be used with any application which talks to a LaserJet compatible printer. However, because of the popularity of the Ventura Publisher package, we've included a width table generator for each collection which will painlessly integrate these fonts into Ventura for you.

Abbo
Amityville
Avantis Basque
Begotten
Big City
Cartoon
Centurion
Channel Channel
Copper
Courier
GalaxyGlue
Garnet **Gillie**
Hoboken
Olivia Optimal
Olde English
Ornation
Palatinus
Prestigus
Rocky
Script
Sebastian
These fonts are shown actual size and are 18 points in most cases with the exception of "Cartoon", which is 56 point.
\$19.95

ALMOST FREE™ GAMES

VOLUME 1

CARD is a simple draw poker game. In addition to genuinely random play, you can shoot it if it cheats without having to worry about its brothers coming after you for vengeance.

CASTLE remains one of the most fun public domain computer games yet devised. Wander around a sort of deserted castle collecting things and trying to find the way out. More fun than sudden, blistering death.

CHESSII is a pretty sophisticated chess game with a graphic board. You can actually pick up and move your pieces, rather than having to enter board co-ordinates. ChessII features multiple look ahead levels, too. Requires CGA or EGA card.

EGAROIDs is a brilliantly executed Asteroids game for EGA and VGA cards. It's fast and deadly... if you get crunched by an asteroid, you suck vacuum. This version corrects the incompatibilities many users encountered with the one previously offered on our almost free software disks.

FROGGER

is a PC version of the classic arcade game. Try to get your frog across the road without him winding up splattered by the traffic. Less messy than real life. Requires a CGA or EGA card.

HAUNT is a text based adventure game in which you attempt to work your way through a haunted house. It's quite a large house, though, with an endless plethora of rooms and objects

LINKFOUR is a computerized version of the popular Connect Four vertical checkers game. Try to get four coloured dots in a row before the computer does. It's a classic puzzle. Requires a CGA or EGA card.

PACKGAL is an ASCII based version of PacMan. It plays like the wind, though, and is every bit as exciting as the arcade version... except that it doesn't inhale quarters.

PINBALL2 simulates the action of a pinball machine on your computer. This one has all sorts of traditional pinball phenomena, including flippers, out lanes, kickers, gates and so on. Requires a CGA or EGA card.

TREK lets you tear through space meeting interesting new life forms and slaughtering them. It's a complex graphic space game with lots of action and even a plot of sorts. There's no blood like green blood. Requires a CGA or EGA card.

WILLY is the strange and wonderful saga of Willy the worm. In this episode, you get to help Willy go home. Willy is a graphic arcade game clearly written by someone a little warped. Requires a CGA or EGA card.

\$19.95

VOLUME 2

BRICKS is a classic implementation of "Little Brick Out", a game which dates back to the earliest personal computer. Kill bricks and relive a bit of history.

FLEES is a lightning fast, arcade quality alien slaughter game... get the space fleas a'for they get you. Slaughter and green blood abound. Requires an EGA card.

PANGO is a rather strange little arcade game. You wander around kicking the hell out of bricks and squashing bees. It's fast and peculiar.

PIRATE is a huge graphic adventure game in which you wander through tunnels searching for buried treasure. The pictures are good, the plot is clever and gory, violent death awaits you. Fun for the whole family if they're a bit blood thirsty.

PITFALL pits you against the most dreaded space enemy of all... gravity. Pilot your ship down through the pit without getting mashed on the rocks. Works with any video card.

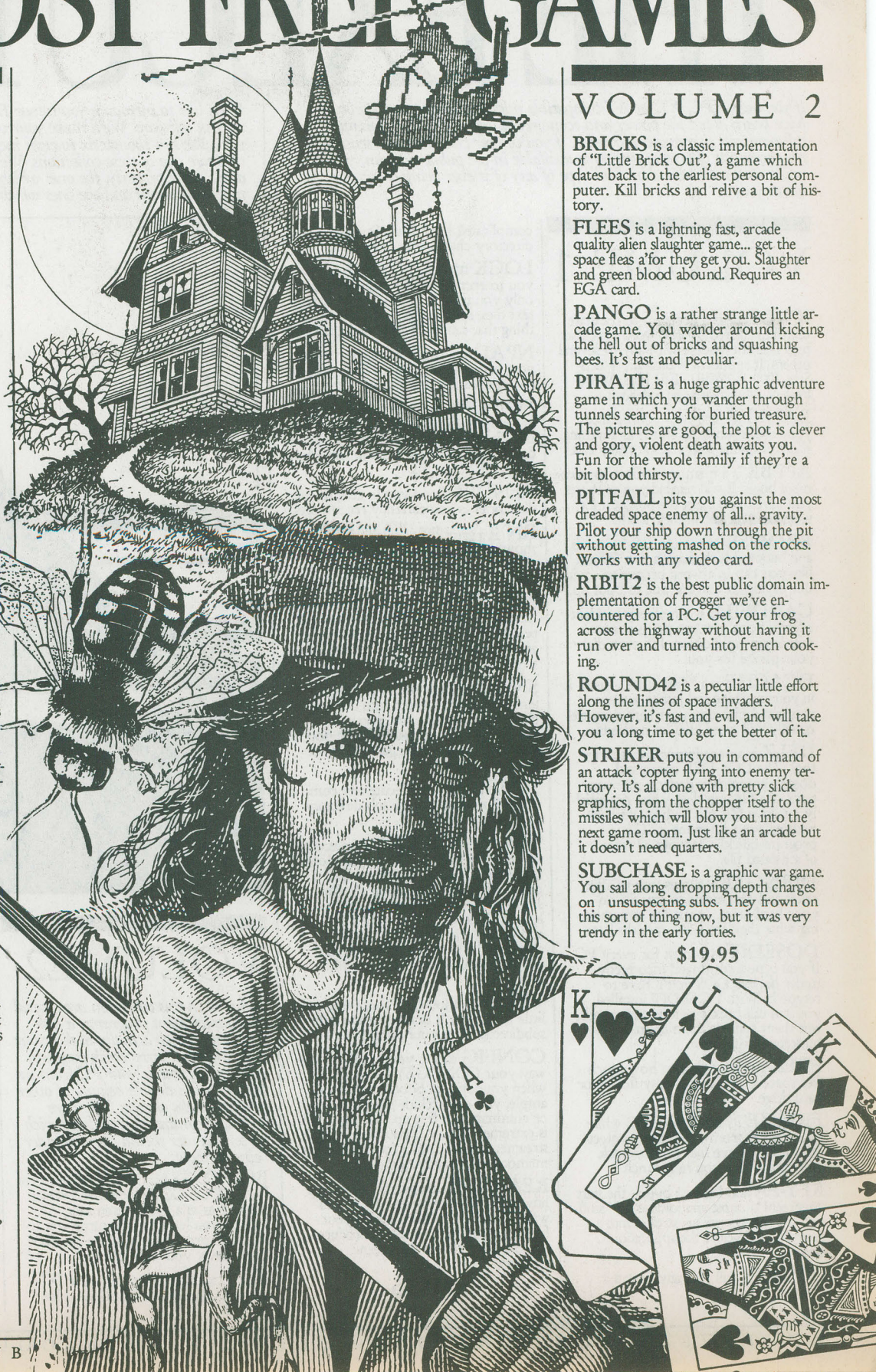
RIBIT2 is the best public domain implementation of frogger we've encountered for a PC. Get your frog across the highway without having it run over and turned into french cooking.

ROUND42 is a peculiar little effort along the lines of space invaders. However, it's fast and evil, and will take you a long time to get the better of it.

STRIKER puts you in command of an attack 'copter flying into enemy territory. It's all done with pretty slick graphics, from the chopper itself to the missiles which will blow you into the next game room. Just like an arcade but it doesn't need quarters.

SUBCHASE is a graphic war game. You sail along dropping depth charges on unsuspecting subs. They frown on this sort of thing now, but it was very trendy in the early forties.

\$19.95



THE EXECUTIVE

If you own a PC, XT, or AT compatible microcomputer, you'll probably have heard about the power and economy of low cost public domain software and shareware. However, if you've ever tried to make sense of the thousands of cryptic programs available in the public domain, you might well have abandoned all hope of any of it ever being of much use to you.

We'd like to introduce you to our Executive Software Series... no fuss, no risk software. We'll make your computer dance... with no piper to pay. We sort through six to eight megabytes of public domain software to create one of these collections. We weed out the programs which don't work properly, the ones which just aren't suitable for business applications and the ones which contain computer viruses.

VOLUME 1

XWORD is a program to translate text files created by one word processor into files compatible with any of several others. It supports WordStar, WordStar 2000, XYWRITE II Plus, WordPerfect, Multimate and SideKick.

BANKER will help you balance your checkbook... as much as anything short of divine intervention really can.

APPBK is a memory resident appointment book. It will remind you of things you have to do... just the program for users who get lost in their work.

BROWSE lets you scroll forwards and backwards through a text file just like you can in a word processor... without having to wait for one to boot up.

CARDFILE is a memory resident address book you can pop up from within any application. It'll even dial your phone for you.

DCACHE is a "disk cache". Install it in your machine and just about any program which uses your hard drive frequently will speed itself up noticeably.

DELZ is a very important security tool. The DOS DEL command doesn't completely destroy the contents of a file you delete, and potentially sensitive files can be brought back without your knowing it. This program quickly destroys all trace of a deleted file.

DIRNOTES allows you to affix notes and comments to any file on your hard drive... great for remembering what they are a few months later.

DOSEDIT is a must for every PC. If you type a command incorrectly under normal DOS you'll have to retype it. With DOSEDIT installed, you can call back previous commands, edit them and use them again. Saves buckets of frustration.

FREE quickly tells you how much free space is available on any floppy or hard drive.

FREEZE locks up your PC while you're away from your desk, protecting your sensitive files from a quick disk copy while you're at lunch.

KEY-FAKE lets you bypass the start up screens of most applications by "stuffing" the appropriate keystrokes into your PC just before the application boots.

LOCATE will find any file on a

complicated hard drive. Saves ages of directory changing and searching.

LOCK and UNLOCK allow you to encrypt sensitive files so that only you can get at them. Works with text files, spreadsheets, data bases... anything that can be illegally duplicated.

NPAD is a small, memory resident note pad you can pop up from within any application to jot things down on.

POP-CAL is a calendar which can be popped up from within any application. It will show you a correct calendar page from any month of any year from 1582 onwards.

RENDIR allows you to rename sub-directories as you currently rename files.

RN is a great little utility which will show you a map of the subdirectories of your hard drive and allow you change directories simply by pointing to the area you wish to log into.

SETUP sends control codes to your printer. It allows you to change fonts and effects with having to remember scores of obtuse escape sequences.

SNIPPER lets you copy the contents of any text screen into other applications. For example, you can extract part of a spreadsheet and pop it into a report being prepared on your word processor.

SWEEP lets you execute any command you like in every sub directory of your hard drive.

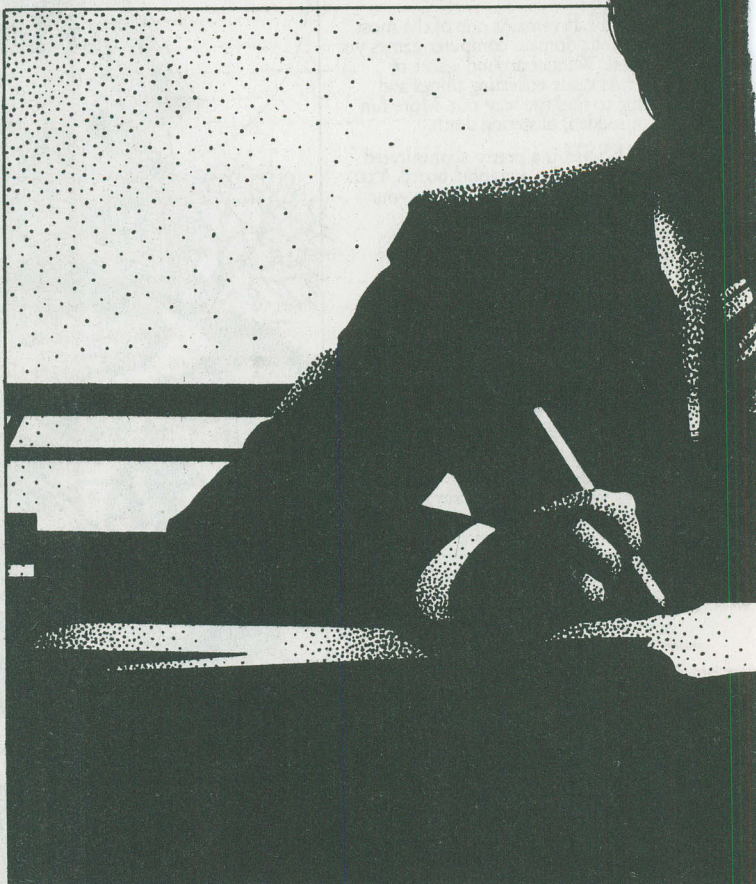
TSR MANAGER is a collection of utilities which will keep your pop up utilities, resident programs and other TSR's from rising up to consume you. Among other things, it lets you load in pop up programs and blow them away later on. It also includes several utilities which will help you identify TSR conflict problems.

VTREE is another of those essential little programs. It draws a map of the subdirectories of your hard drive.

CONFIG allows you to change the way your CONFIG.SYS behaves when your system boots up. For example, you can exclude specific drivers or commands to free up memory. This is extremely handy if you have a tape streamer, a LAN and a couple of other memory pigs in your system.

READRITE allows you to analyze how readable your writing is... as you write it. It pops up from within your favourite word processor and produces a readability index of the screen contents.

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VOLUME 2

Included in this collection are several file management programs, a disk formatter which actually makes your disks bigger, a virus check program that really protects your PC from infection and a double helping of other powerful slabs of code. There are several programs on this disk which no serious user should even consider being without.

BCOPY is a handy little replacement for the DOS COPY command which copies files as a background task. As soon as you let it go, it returns you to the DOS prompt so you can get back to whatever you were doing.

BELL makes the beep in your PC sound like an electronic phone. Not

likely to affect the bottom line, this, but it's very small and kind of fun.

NJFRERAM will tell you how much free memory is left in your machine from minute to minute, even when you're inside an application. This is a great asset to spreadsheet users.

CASE will convert text into all lower case, all upper case, capitalized words and it'll even clean up WordStar files.

MAXI is a disk formatting program which will allow you to get four hundred kilobytes on a regular 360K disk, or almost a megabyte and a half on a quad density disk. Speeds up your hard drive backing up considerably.

POPCALC is a handy four banger calculator which pops up in a window whenever you need it.

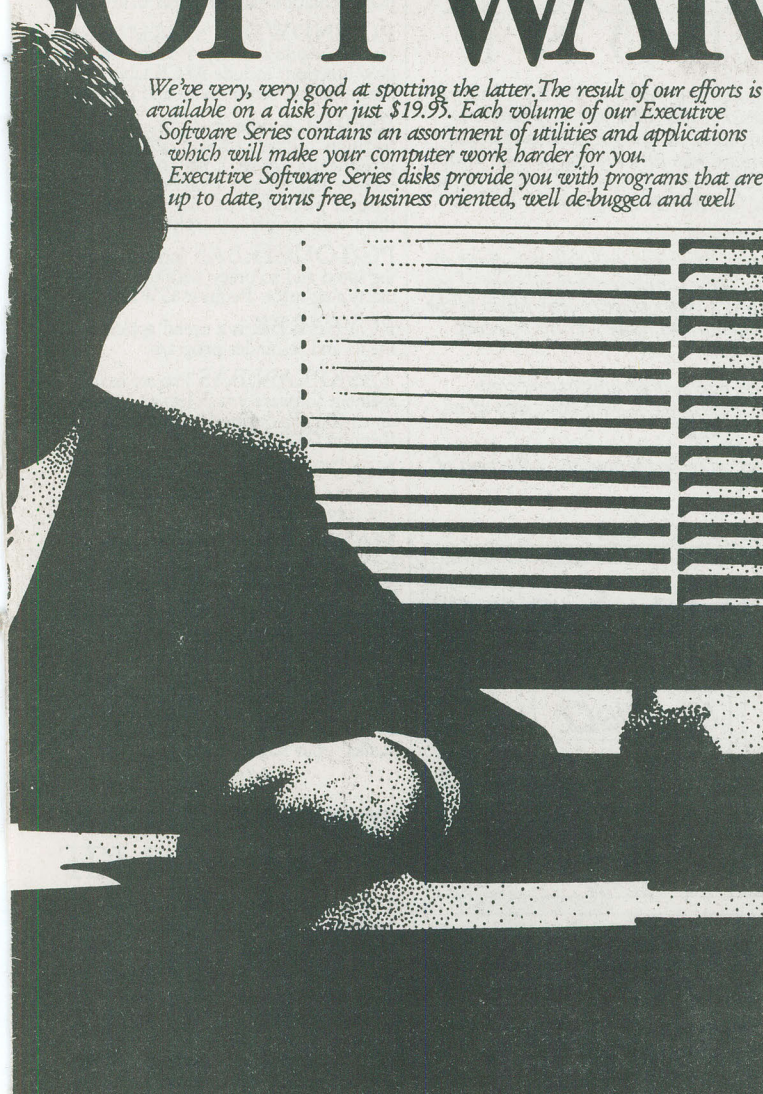
TONTO is a sort of SideKick clone which provides a number of useful functions in a window when you call it forth.

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VOLUME 3

CLEARCUT will make your writing more readable by helping you to spot excessively large or difficult words.

CALLFOR is the pop up equivalent of those pink message slips that litter most offices. It can be called up when the phone rings.

SHFTPIICK allows you to skip over the loading of resident programs when your computer boots up.

SMOOTH is a text "browsing" program which lets you read through documents by smooth scrolling. EGA or VGA card required.

VALET is a DOS shell which allows you to use simple menus rather than complex typed commands to handle the common functions of moving files, changing directories and so on.

WIPE will obliterate every trace of a file... the DOS DEL command allows deleted files to be restored posthumously. Essential for sensitive data.

YEARCAL will print up a calendar for any month of any year in the twentieth century... but it does so with buckets of permutations, in sixteen languages.

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BANNER prints up any phrase you like as a huge banner lengthwise along a strip of printer paper.

CALENDAR is a handy desk calendar and daily planner with lots of options. It's much harder to misplace than the paper kind are.

COVER will print the directory of a floppy disk so that it slips into the disk sleeve and serves as a permanent reminder of what's on the disk.

DISKLITE is for people with machines that have internal hard drives and hard-cards. It tells you when the drive is running by putting a flag up in the corner of your screen.

PALERT will warn you when you're close to running out of disk space, keeping you from having a computer full of work and no way to save it.

BOTH lets you print long text files on both sides of the paper.

LOCKERUP lets you lock your keyboard instantly when you have to step away from your system, protecting it from casual unauthorized access.

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VFILER is a simple file manager which will help you move, copy, rename and delete lots of files without lots of typing.

WHEREIS locates files on your hard drive... no matter where they're lurking.

MCOPY is a DOS COPY replacement with lots of features. It will copy files over multiple floppies if you have too many files to copy onto one, prompting you to swap disks. It uses a sophisticated algorithm to make sure you use your floppy space as efficiently as possible. It's a replacement for BACKUP and RESTORE in this case. Also does CRC checks of each file to make sure your important data isn't corrupted.

ADDRESS is a resident envelope addresser which works with most popular word processors. It allows you to roll an envelope into your printer, hit a key and have the envelope addressed automatically, copying the address from the screen of your PC. In addition, it will also print

a text or specially designed graphic return address on every envelope if you like.

VCHECK protects your system against those computer viruses you've read so much about. It checks sensitive files in your computer to make sure they haven't been infested.

SETALARM is a simple memory resident reminder that will beep at you at a pre-arranged time.

SILENCE kills the speaker in your PC when you don't want to be beeped.

VTREE2 is an enhanced version of the VTREE program on our last disk... there's always one more version. It maps out the tree structure of your hard drive and tells you how much space each directory occupies.

WORLDTIME will tell you the correct time in any city in the world.

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VENTURA SURVIVAL DISK VOLUME ONE

If you use the popular Ventura desktop publishing package, you'll probably be aware of a few of its... ahem... deficiencies. For example, you may have encountered the monumental difficulties involved in using it with additional soft fonts. Perhaps you've tried to pour image files into documents and found them a bit awkward. What about the unspeakable boredom of having to use the same type faces over and over again... it's driven lesser mortals back to their typewriters.

As long-time Ventura users ourselves, we've developed and collected quite an assortment of Ventura support programs. These things perform all sorts of useful functions, mostly with making Ventura a better place to live. Much of the software in this collection is specifically intended to make Ventura co-exist peacefully with a LaserJet compatible printer.

This is the first time we've offered all these handy programs in one comprehensive collection... and the first time some of them have been seen at all. These are the latest versions of all of these utilities.

If you publish with Ventura, you can't afford to be without this collection of programs.



FONTILT is a splendid program for making boring fonts into exciting ones. It inhales any standard LaserJet soft font and outputs a font with your choice of special effects added to it, including drop shadows, bounding boxes and even dripping blood.

VFM manages your Ventura soft fonts. It quickly makes width tables without any batch files to contend with, allowing you to add fonts to Ventura painlessly. This is a must for any Ventura user.

GEMSCOOP lets you view and optionally print out any GEM/IMG image file... without having to load Ventura. Supports CGA, Herc and EGA/ VGA monitors as well as LaserJet, PostScript and FX-80 printers.

PCXSCOOP is a version of GEMSCOOP for PC Paintbrush images.

MACSCOOP is a version of GEMSCOOP for MacPaint images.

HP-SLASH will reduce the often times voluminous sizes of soft font files by allowing you to selectively "prune" out unused characters and symbols. Saves on hard drive space and really speeds up font downloading.

MAC2PCX converts popular MacPaint files into PC Paintbrush PCX files, giving you access to a whole

plethora of instant clip art. If you have PC Paintbrush, this will make it easy for you to edit and modify MacPaint image files.

MAC2IMG converts MacPaint files directly into the GEM/IMG paint form used by Ventura. Saves on conversion time, disk overhead and gets around one of Ventura's long standing bugs.

TCAP is a memory resident program which captures text screens as GEM/IMG graphics suitable for pouring into Ventura documents as pictures. These screens preserve the original screen attributes and can be scaled to any size from within Ventura.

GCAP captures monochrome graphics screens into GEM/IMG files, suitable for pouring into Ventura chapters. A Windows compatible version is also included.

FSEE is a quick 'n nasty program to let you view the contents of a soft font file on your screen before you print it. It lets you see what new fonts will look like without your having to download them and print them out.

VPSCREEN is a Ventura screen font editor. It allows you to change the way fonts look on your screen.

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BUSINESS

MA.BAS The Micro Accountant is a complete, working accounting and check register program, with a 25K documentation file. Requires BASIC.

PCWINDW22 A "Sidekick"-like co-resident window utility. Pop-up window functions include ASCII table, alarm, printer setup utility and notepad.

PSHIFT A time saving 'memory partition' utility. Lets you define up to nine memory areas. Load programs such as dBase II and WordStar into separate partitions and 'flip' between them with simple keystrokes.

PC-TOUCH.BAS Increase typing speed and accuracy with this easy-to-use typing tutor. Requires GWBASIC.

PCYEARBK is a useful appointments and reminder program.

TASKPLAN.BAS Project management software which lets you track up to 50 tasks during 50 time periods. Requires GWBASIC.

NOCOLOR A handy little utility for users with monochrome monitors and colour software.

MAXIT A simple but subtle game for two human opponents, or one player and the computer. Hours of fun!

PERTCHT A sophisticated project management tool using the Program Evaluation Review Technique.

PLUS More utilities to help organize maintain and copy your files, including a "monitor saving" program which blanks your screen when not in use.

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If you have a hard drive you can have all sorts of powerful utilities and programs installed in your system to make use of it more efficiently. We've collected the best of these utilities on a single disk to help new PC users get the most from their hard drive systems. Please note that these programs are included in our other almost free software disks. Descriptions of them are provided elsewhere in this catalog.

HGC	Colour card emulator for Hercules
ADDRESS	Resident envelope addresser
WHEREIS	Hard drive file finder
SIZE	File size finder
SETUP	Resident Epson printer setup
RENDIR	Sub-directory renamer
POPALC	Resident perpetual calendar
CLOCK	Screen clock
EDWIN	WordStar like editor
NANSI	Screen driver
CACHE	Disk cache
RAMDISK	RAM disk program
LPTX	Printer redirection
MURPHY	Foolishness and wisdom
LOCKERUP	Security system
BOTH	Printer paper saver
PCWINDOW	Resident grab bag
PRINTPRESS	Prints things very small
NOTEPAD	Resident notepad
FREE	Free space finder
HOTDOS	Multiple tasker
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UNWS	WordStar converter
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VTREE	Hard disk map
VFILER	File manager
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DOSEDIT	Command line editor

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Continuity Tester *Continued from page 19*

mediately suggests that we might be able to use a comparator. A standard bridge network is ideal for this sort of application and the circuit diagram Fig. 1 shows the basic scheme.

When resistors $R1/R2 = R_x/R3$, the input voltages to the comparator are equal. If we make $R1 = R2 = R3 =$ one ohm, then if R_x is less than one ohm the comparator's positive input is highest, and the output is high. Conversely, if R_x is greater than one ohm, then the output will be low. If we now change $R3$ to one megohm by using a switch, then we have a device that will detect open circuits too.

The "sense voltage" is the voltage that appears between the test probes for an open circuit. If the sense voltage was 2V, diodes would appear as a short circuit, since with a forward voltage drop of 0.7V,

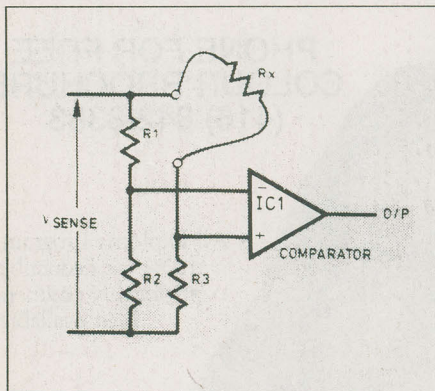


Fig. 1. Basic comparator principle.

the positive input of the comparator would be highest.

This is clearly no good (unless we want to use the device to check diode polarity). Another reason for reducing the sense voltage is that we do not want to damage the circuit under test by applying large voltage biases between two parts of an unpowered circuit. Therefore, a sense voltage of 0.2V has been chosen for this design.

Moving on to consider power consumption, since we are using a linear IC (the comparator) we will probably need a supply voltage of at least 6V. A 9V battery is appropriate since they're small and easily available.

With the circuit so far described, a short circuit between the probes will cause a current of $I = V/R - 0.2V/1\text{ohm} = 200\text{mA}$ to flow. This is far too large if we want the battery to last very long.

The other thing we must consider is how to generate the sense voltage in the first place. Fig. 2 shows how these problems can be overcome.

In order to reduce the current, resistor $R5$ has been added. Both $R3$ and $R5$ are 220 ohms. We have now complicated the issue by trying to resolve the difference between 220 ohms and 221 ohms. In this situation the input offset voltage of the comparator has a direct impact on the resistance resolution. Varying R_x from 0 to 1 ohm will change the voltage on the comparator positive input by one ohm x

$0.2V/(R3 + R5) = 0.5\text{mV}$. This has to be sufficient difference for the comparator to change state.

Comparators are normally optimized for fast switching applications. Since we do not need fast switching performance in this application, we can use an op amp IC instead. An ideal power economic op amp IC is the LM308. It has a current consumption of just 0.3mA and an input offset voltage of 2mV. The offset looks too large for our needs, but in fact this does not turn out to be a difficulty.

Output

An important consideration is the type of output we require from the tester. LED outputs are simple to implement, but take a lot of current (10mA-15mA). Also, and perhaps more importantly, it is often difficult to look at the test probes (to keep them in the right place) and an LED indicator some distance away, at the same time. An audio output, however, is just what the doctor ordered to reduce this sort of eyestrain.

Using a conventional eight ohm speaker will be wasteful of power, and a preferable method is to use a piezoelectric transducer. A suitable audio interface circuit diagram is shown in Fig. 3.

Since the output of the op amp will be neither high (9V) or low (0V) for marginal values of resistance but somewhere in between, a Schmitt trigger buffer is needed to turn it into a clean on/off signal. See Fig. 4.

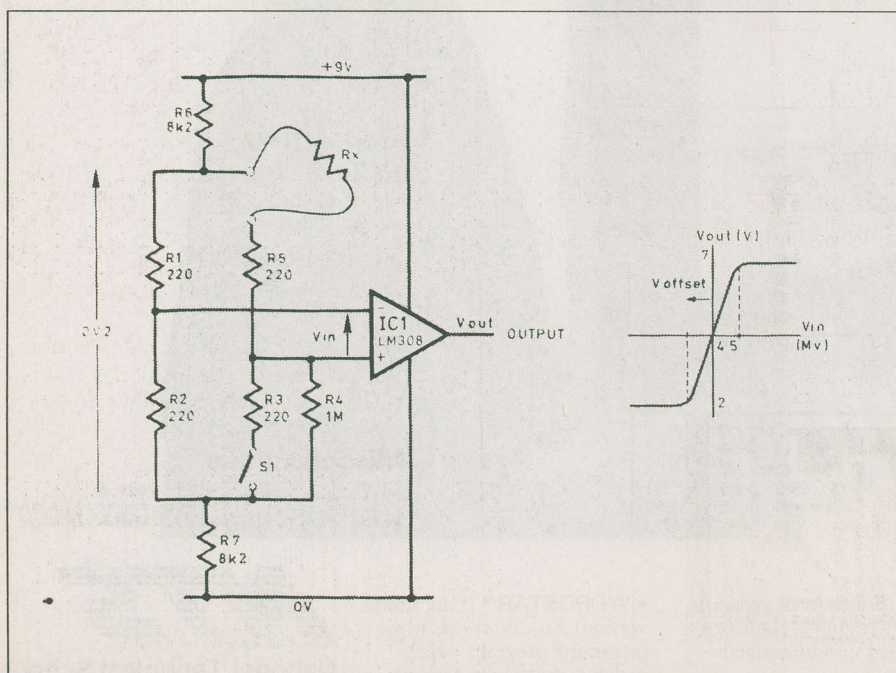


Fig. 2. Improved sense network.

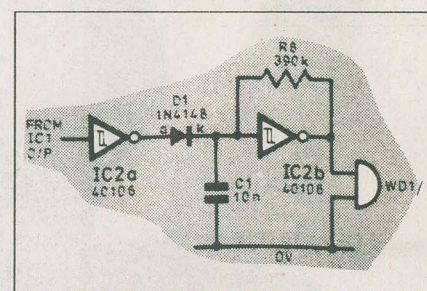


Fig. 3. Audio output stage.

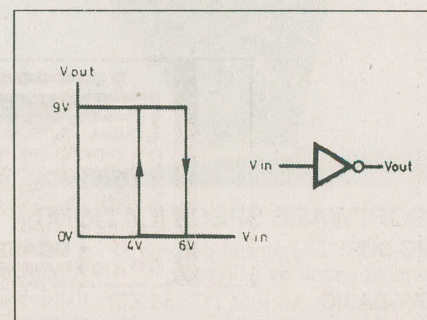


Fig. 4. Schmitt trigger characteristics.

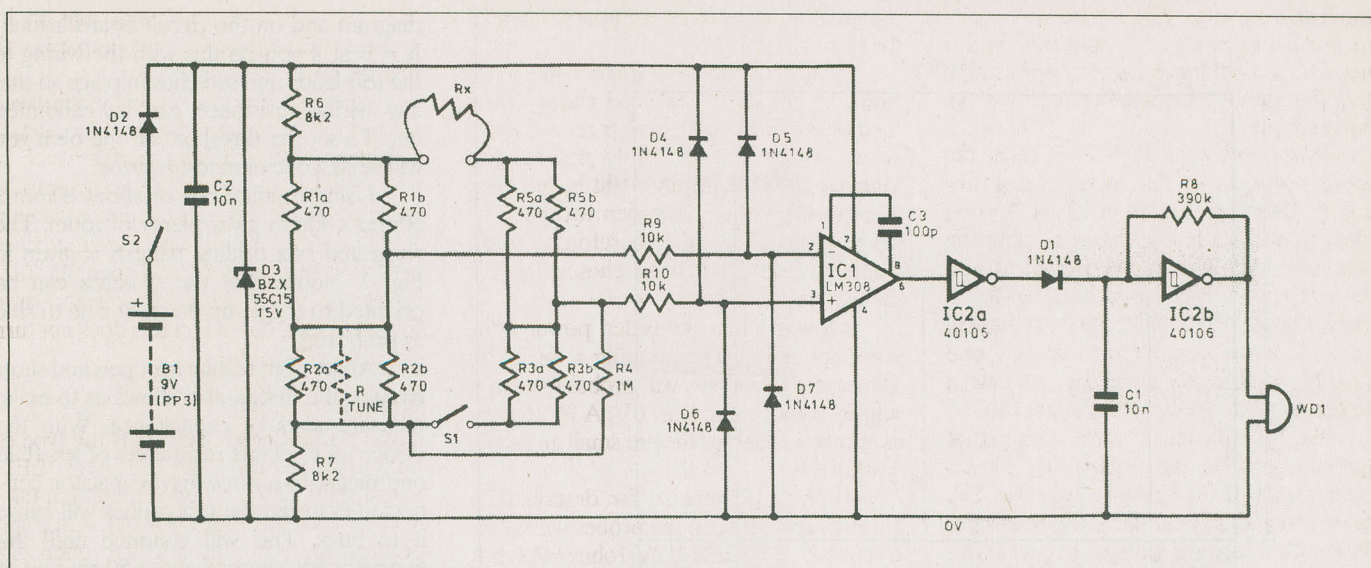


Fig. 5. Complete schematic for the Continuity Tester.

By effectively introducing this threshold on the op amp output, the resolution of the device is increased over what one might expect given the input offset of the op amp. The CMOS CD40106 (IC2) is a good choice here since it consumes virtually no power and will run happily from a 9V rail.

There are six Schmitt inverters on the chip and we can use one of the others to make a square wave oscillator. The values of R and C are chosen to give an audio output of about 1kHz but the exact frequency can vary depending on the

thresholds provided by the Schmitt inverter. By varying R or C slightly you will be able to produce a tone your are happy with.

The piezo-electric transducer WD1 is driven directly by the oscillator output. The oscillator output is disabled when the first inverter output is high.

This leaves four other inverters that are spare. If you wish these can be used to drive an LED indicator (all connected in a parallel configuration), or to produce two tones (one for one megohm, one for one ohm).

PARTS LIST

Resistors

All 0.25W 5%, except where stated.

R1a,b, R2a,b, R3a,b, R5a,b 470
.25W 1%

R41M
R6,78k2
R8390k
R9,1010k
Rtune (see text)

Capacitors

C1,2 10n
C3 100p

Semiconductors

D1,2,4 to D7 1N4148 signal
diode
D3 15V Zener diode
IC1 LM308 op amp
IC2 40106 Schmitt trigger

Miscellaneous

S1,2 spdt toggle switch
WD1 piezoelectric transducer

Case, test lead sockets, black and red; 9V battery and connector; connecting wire; solder; etc.

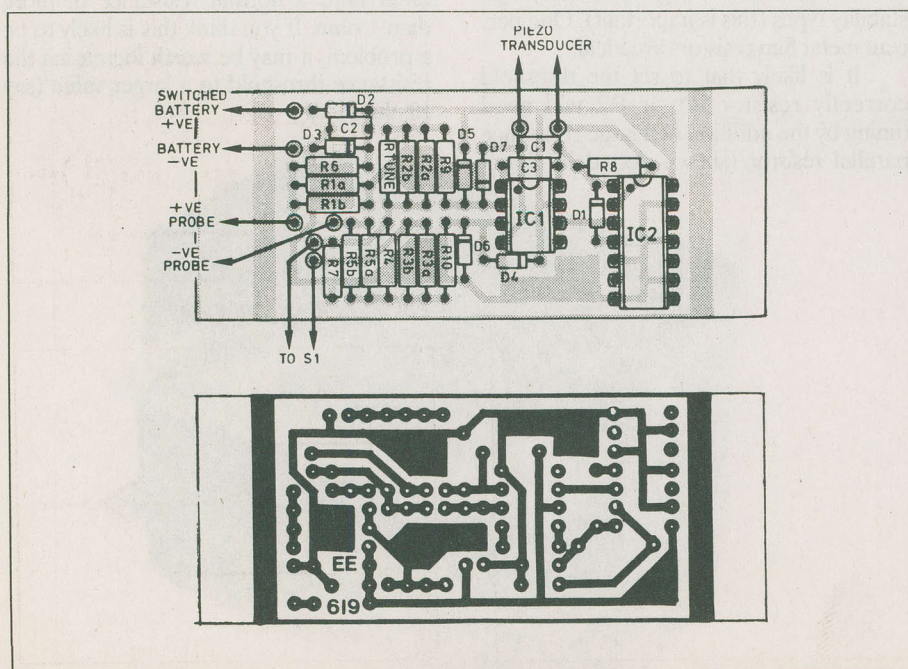


Fig. 6. The PCB layout and wiring for the Continuity Tester.

Continuity Tester

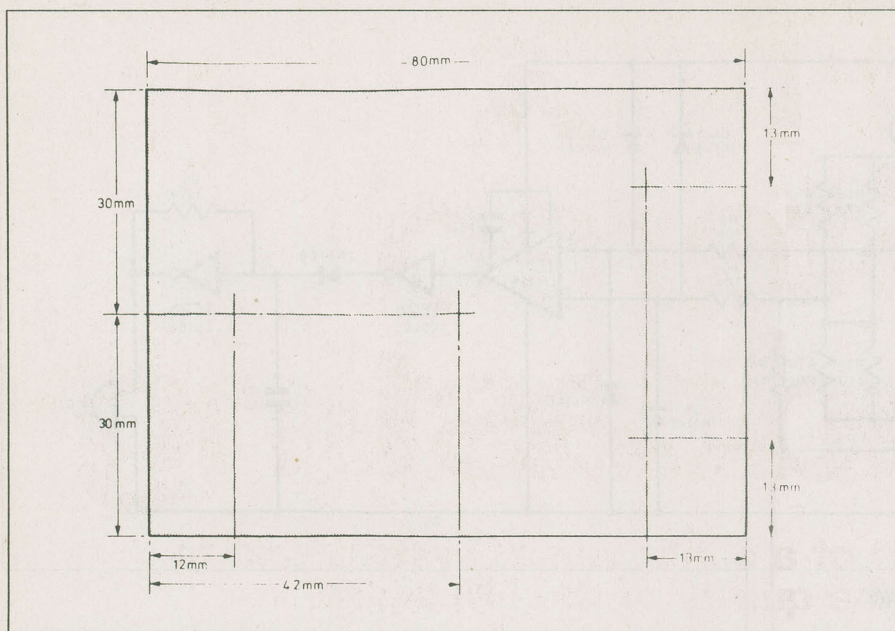


Fig. 7. The case drilling details for the size of case listed in the text; other sizes can be used.

Idiot Proofing

The design given so far will perform well in tests on unpowered circuitry. However, it is inevitable that eventually it will be used on powered circuitry by mistake. We have to make sure that the tester is not destroyed. One might expect the worst case to be connection across a plus and minus 15V supply, or 30V between the test probes.

From Fig. 2 there are several ways in which damage could occur:

(a) Resistors R1, R2, R3, R5 get hot. 30V across 4 x 220 ohms gives 1/4W of power dissipation in each resistor.

(b) Current will try to get pumped into the battery.

(c) Op amp input pins may be biased at voltages outside the voltage appearing at the supply pins.

(d) If the supply rail exceeds 20V, the CMOS chip will fail.

Final Circuit

The complete circuit diagram for the Continuity Tester, Fig 5, shows how we can protect against the above problems. Resistors R1, R2, R3, R5 are now pairs of 470 ohm (1/4W) resistors rather than single 220 ohm resistors (alternatively single 1/2W 220 ohm resistors could be used). These will be able to withstand the additional power consumption.

Diode D2 prevents current going into the battery, and the Zener diode D3 stops

the supply rail exceeding 15V. Resistors R9, R10, and diodes D4 to D7 prevent overvoltage and overcurrent of IC1 op amp inputs.

Construction

The printed circuit board and full-size copper foil master pattern for the Continuity Tester is shown in Fig. 6.

Construction requires no special consideration, except that the resistors R1, R2, R3, and R5 be high tolerance, high stability types (this is important). One percent metal film resistors are ideal.

It is likely that to set the threshold correctly resistor R1 or R2 will need tuning by the addition of a large resistance parallel resistor (shown dotted in circuit

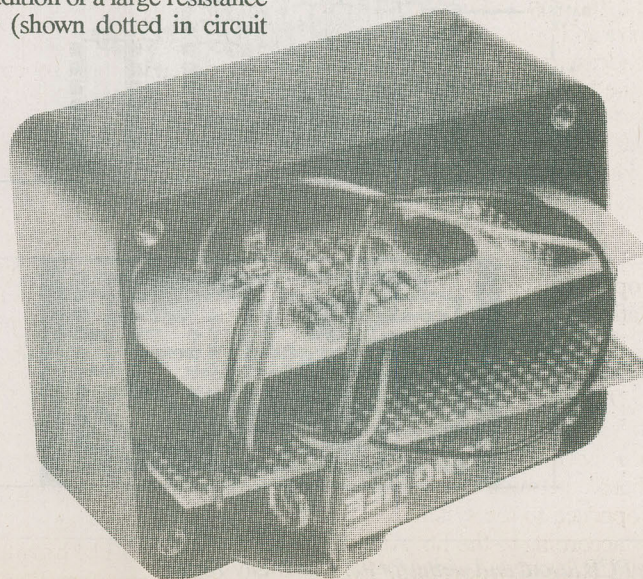
diagram and on the circuit board layout.) It is best if you do this with the wiring to the test leads and switches in place so that any wiring resistance can be calibrated out. To set the threshold at one ohm you will need a one ohm test resistor.

Using a utility box of about 80mm x 60mm x 40mm gives plenty of room. The suggested box drilling pattern is given in Fig. 7. Notice that the switches can be oriented to toggle up/down or side to side as preferred.

Apart from testing for open and short circuits, the design also allows us to make measurements of capacitance. With the device set to detect resistances of less than one megohm a discharged capacitor connected between the test probes will cause it to buzz. This will continue until the capacitor has charged above 50 percent of the sense voltage, when the buzzing will stop.

This behaviour can be well described mathematically, and it turns out that for the circuit values we have used the duration of the buzz (seconds) = $0.7 \times C$, where C is in microfarads. With the aid of a watch then, capacitors in excess of 1uF can be measured. However, larger electrolytic capacitors can be leaky and if the leakage current exceeds 100uA then the Continuity Tester will not stop buzzing.

The tester is ideal for testing domestic fuses, but be careful when it comes to testing very low current fuses, since these often have a normal resistance of more than 1 ohm. If you think this is likely to be a problem, it may be worth increasing the resistance threshold to a larger value (say 10 ohms). ■



FMX Stereo Broadcasting

The introduction of a controversial system said to improve the quality of the FM signal.

TIMOTHY PALMER-BENSON

Journalists who cover the U. S. electronic scene are scratching their heads over a battle between proponents of a new method of FM broadcasting and opponents who claim the method is totally disastrous. The battle is over FMX, a new FM broadcasting technology. FMX is claimed by its proponents to provide a 15dB reduction in signal-to-noise (S/N) in FM stereo, provided that the receiver is equipped with a special FMX chip manufactured by Sanyo and Sprague. FMX was demonstrated a year ago at the Chicago Consumer Electronics show by its US developer, Broadcast Technology Partners (BTP), a company formed by engineers from the now defunct CBS Technology Centre and by the National Association of Broadcasters (NAB). Some 50 FM stations in the US have changed over their transmitters to the new FMX system since then. (As far as I know, no Canadian stations have done so.)

Opponents of the FMX system say that it can only provide good results under ideal conditions, but that these seldom exist. The opponents argue that whenever multipath affects reception, the signal-to-noise ratio (S/N) becomes unacceptable and distortion rises. Multipath is a fact of life, almost 99% of the time even under "direct line of sight" conditions, say the sponsors of a recent forum on FMX.

The battle between the "FMXers" and those opposed to the system has now turned ugly according to the Dr. Amar G. Bose of the Bose Corporation. Bose,

through its public relations firm, Borman Associates, recently flew journalists in the electronic field from all over North America to Boston (at Bose expense) so that they could attend a lecture at the Massachusetts Institute of Technology. The lecture, delivered by Dr. Bose and Dr. William R. Short, (both of the Bose Corporation) caused somewhat of a stir when Dr. Bose announced that he and his staff were being threatened with legal action should their criticism of the FMX system continue. Notwithstanding this, the researchers went ahead with their one and half hour lecture on why North America must be saved from FMX.

To understand what the fight is all about, it is necessary to describe how FMX works. The system is based on the use of an additional subcarrier and stereo-difference companding. In a conventional FM stereo broadcast consists of three signals. The left and right audio channels are summed to create a compatible monophonic signal, M (see Fig.1). In addition, the left and right channels are subtracted to create a difference channel. This channel is multiplied by a 38kHz carrier, resulting in a double sideband suppressed carrier subcarrier signal, "S." A pilot signal, "P", at 19kHz is also provided to allow the receiver to recreate the 38kHz carrier needed to demodulate the "S" signal. These three signals are summed together to create the total composite signal that is fed to the transmitter.

The basic FM broadcasting system is by no means perfect. For one thing, when

an FM signal is being transmitted, low level white noise gets added to the M and S signals. When a receiver converts these signals back to their original form, the added noise produces a noise spectrum that is proportional to frequency as shown in Fig. 2. As a result, the S signal has an inherently poorer S/N ratio than the M signal. The difference is slightly more than 20 dB when 75 microsecond de-emphasis is used and explains why there is an increase in background noise when one switches an FM tuner from mono to stereo.

The FMX system is claimed to improve the S/N ratio through the use of a fourth signal added to the composite audio. This additional signal is a compressed version of the difference channel. It is created by taking the normal difference channel and raising its level at low and moderate modulation levels and reducing its level at high modulation levels. The compression curve in Fig.3 illustrates what happens. For an FM tuner, the S' signal (compressed curve) is higher above the noise level at low modulation levels than the S signal level (straight line trace). At high modulation levels, where even the S signal is above the noise, the S' signal nearly vanishes, which would allow modulation levels as high in FMX as with a conventional stereo broadcast provided that the FMX compressor worked instantaneously.

The FMX composite signal is created by the audio in the compressed difference channel which modulates an additional 38kHz subcarrier in quadrature to the S

FMX Stereo Broadcasting

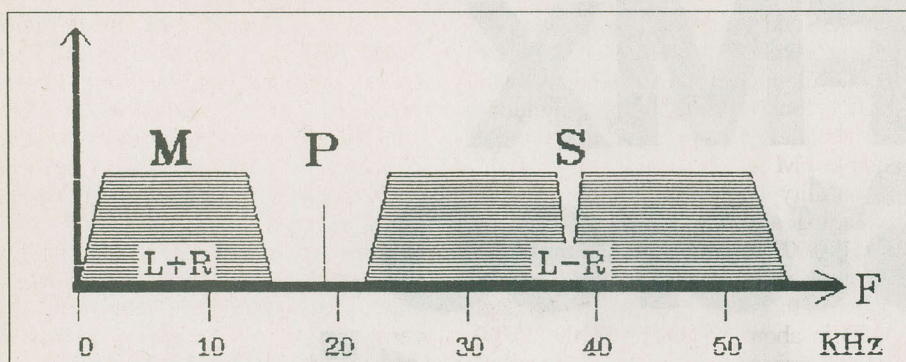


Fig. 1. The spectrum of the FM stereo composite signal.

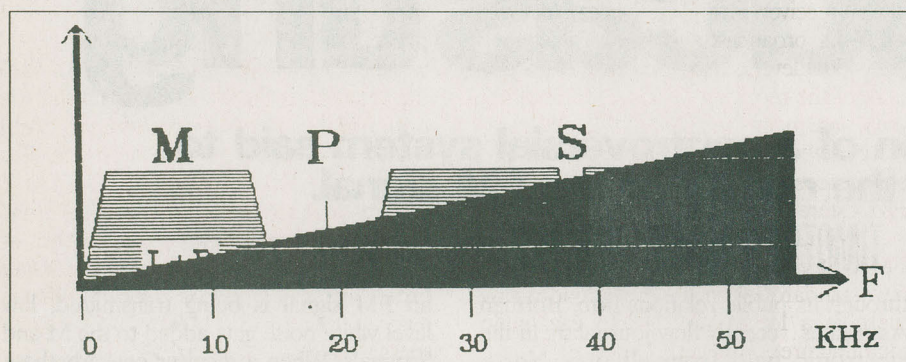


Fig. 2. The spectrum of the FM stereo composite audio signal showing added noise due to the channel and receiver.

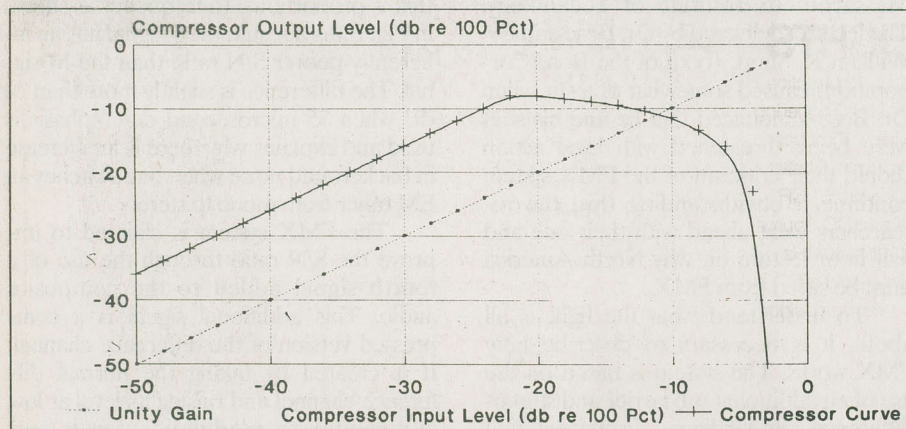


Fig. 3. The FMX compressor curve.

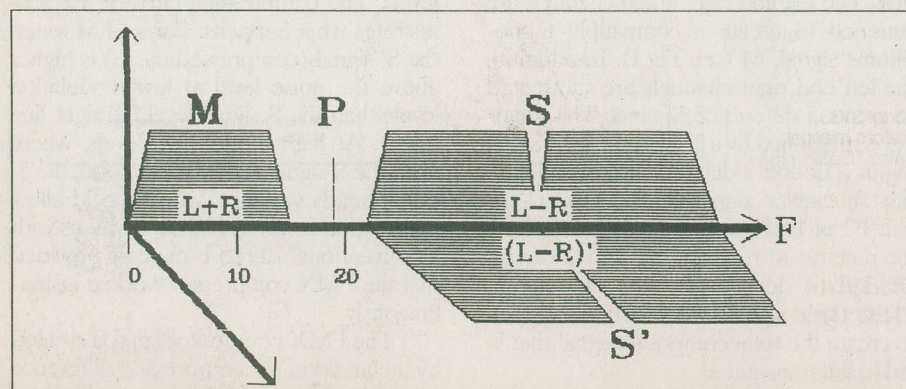


Fig. 4. The spectrum of the FMX composite audio signal.

signal, again using double sideband suppressed carrier modulation. This additional signal is added to the conventional M, P and S signals as shown in Fig. 4. A conventional stereo tuner is insensitive to the S' signal but an FMX equipped tuner can recover all four signals. An expander in the FMX tuner returns the compressed S' signal to its correct value while the S signal, which is at the correct level, but which is noisy, is used as a template for the compressed difference signal. The expanded difference signal is then used with the M signal to recreate the original left and right audio channels. With the FMX compressor at the transmitter and the expander in the FMX tuner being complementary, the audio is the same but with a greatly improved S/N ratio.

According to Bose corporation whose research was funded by a "well known but unidentified car radio manufacturer," (but widely rumoured to be GM Delco) the system works well under "ideal laboratory conditions," but falls short of its promise under multipath conditions. The researchers say that FMX suffers from multipath more than conventional stereo because its signal contains more high frequency energy than a conventional stereo signal in all cases except at high modulation levels. Moreover, they claim that the additional high frequencies cause multipath effects to be more severe with FMX than with a conventional stereo broadcast, regardless of reception mode. Reporters were provided with spectrum analysis plots of the composite signal for both an FMX and a conventional stereo broadcast when it was subjected to identical multipath conditions. Fig.5 shows that the FMX signal has considerably more distortion, not only in the S signal which a conventional stereo receiver reproduces, but also on the M signal which a mono tuner reproduces.

Bose also claims that multipath conditions also generate a phase shift between the pilot and the subcarriers, forcing a conventional receiver to decode not just the S signal but rather some combination of the S and S' signals. This is said to result in arbitrary expansion and contraction of the stereo sound stage. In addition, Bose researchers say that multipath conditions generate quadrature distortion products, which affect the quality of the S signal and result in crosstalk between the S and S' signals.

BTP calls the Bose claims misleading in the extreme. The company says the FMX system has already received broad acceptance in the market and if the Bose

research were truly representative of FMX performance, the technology would never have been adopted by broadcasters or manufacturers. BTP says that the "on air" tests conducted by Bose in Boston were flawed. BTP complains that it offered to align the transmitter involved (WMBR, a 200-watt college station) but that this was refused. As a consequence, says BTP, the taped results of the broadcast show clear evidence of compressor misadjustment and synchronous amplitude modulation (sometimes mistaken for multipath). "Both contributed significantly to a distorted effect that BPT engineers have detected in other FMX installations prior to adjustment of the transmitter," says BPT. The company also charges that the car used in the Bose experiments was taken to a fringe reception location and was parked in a multipath null during comparison of FMX and regular stereo reception capability. Furthermore, BPT engineers dispute the Bose researchers, saying that in a real world environment, multipath reception involves multiple reflections which are randomly

received and rarely sum to produce the destructive effects found by the Bose testing. "BPT engineers have studied multipath extensively and have concluded mathematically that in the universe of all audible FM stereo multipath events, the probability of encountering one with damaging audible effect simulated by Bose is 0.000015% or one in 6.7 million!"

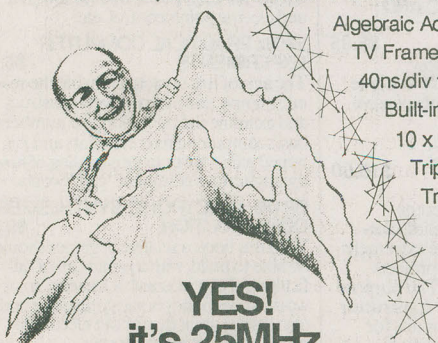
Bose and Short say that their field testing shows that noise and distortion exceeds -40dB in about 12 percent of the 15,000 sample receiving locations used with a conventional FM stereo broadcast and an FM stereo receiver. However, they say that with an FMX broadcast and an FMX receiver, the -40dB level is exceeded in over 25 percent of the receiving locations. In addition, twice as many audible amplitude errors were detected when a conventional FM stereo receiver was used to reproduce an FMX stereo transmission.

With BPT aiming for the adoption of FMX Stereo throughout the world as a new standard for FM stereo broadcasting there is a lot at stake. Two car audio manufacturers, JVC and

Alpine/Luxman, have already introduced FMX in some of their new lines. Other Japanese manufacturers are expected to follow. Dr. Bose and Dr. Short say FMX transmissions degrade reception of existing FM stereo receivers and that FMX receivers are inferior to existing FM stereo receivers for receiving FMX transmissions. According to the researchers, "the FMX system, in the process of trying to solve a second-order problem with FM stereo, introduced a significant artifact in the first order problem - multipath."

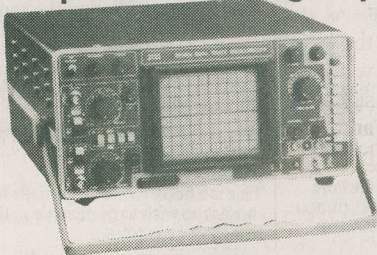
BTP in a statement issued to reporters a week after the Bose-Short presentation says it cannot understand why the event was kept secret from it until the last moment and that it was denied the opportunity for a serious rebuttal. "And what might be the role of the mysterious radio manufacturer which Dr. Bose refuses to identify?" asks Emil Torick, BTP's president. Whatever the motives of the parties involved perhaps Canadian broadcasters should take a look at what is involved here and whether FMX represents a real improvement. ■

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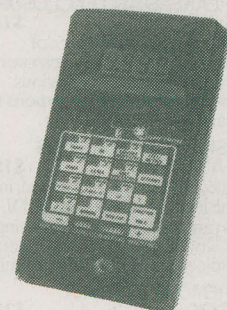
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F.G. Rayer, T. Eng., (CEI), Assoc. IERE.
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome.

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Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

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R.A. Penfold
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, and more.

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Twenty useful projects which can all be built on a 24 X 10 hole matrix board with copper strips. Includes Door-buzzer, Low-voltage Alarm, AM Radio, signal Generator, Projector Timer, Guitar Headphone Amp, and more.

BP103: MULTI-CIRCUIT BOARD PROJECTS \$7.80

R.A. Penfold
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP98: POPULAR ELECTRONIC CIRCUITS \$9.00

Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

BP195: AN INTRODUCTION TO SATELLITE TELEVISION \$15.00

For the absolute beginner or anyone thinking about purchasing a satellite TV system, the story is told as simply as such a complex one can be.

BP106: MODERN OP-AMP PROJECTS \$7.80

R.A. Penfold
features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

BP107: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 1 \$9.00

R.A. Penfold
A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects featured in this book have been specially designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components it is possible to build, in turn, every project shown.

BP122: AUDIO AMPLIFIER CONSTRUCTION \$6.75

A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS \$12.00

The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP108: INTERNATIONAL DIODE EQUIVALENTS GUIDE \$7.00

Cross-references European, American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDs, Diacs, Triacs, SCRs, OCIs, photodiodes, and display diodes.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - BOOK 2 \$7.60

R.A. Penfold
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

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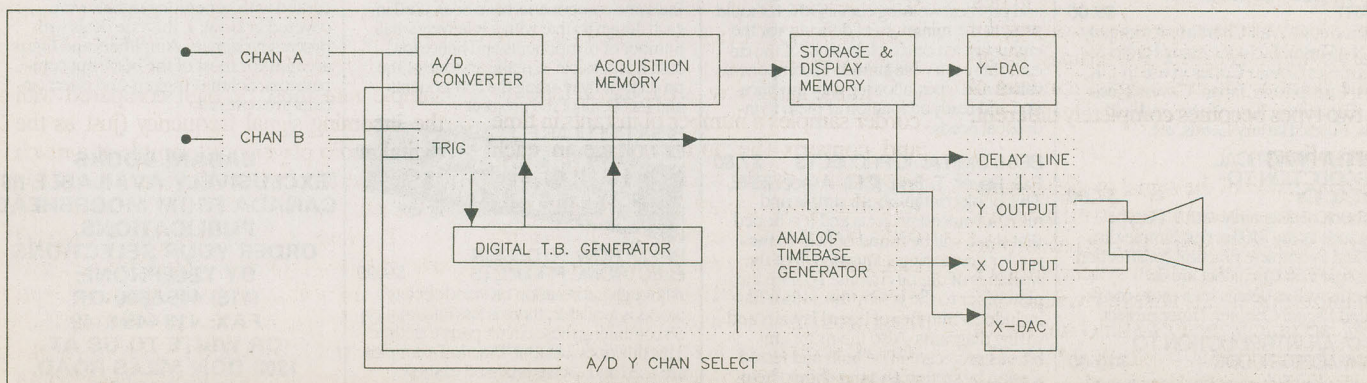
Digital Storage Oscilloscopes

The DSO combines the basic functions of the scope with computer storage and analysis.

BILL MARKWICK



The Philips PM 3335, 3350 and 3365 digital storage scopes range from 50 to 100MHz and sampling rates from 20 to 100 MS/s; with automatic setting of vertical and horizontal controls. Fluke Electronics, 400 Britannia Rd. E., Unit #1, Mississauga, Ontario L4Z 1X9, (416) 890-7600.



The block diagram of a sampling storage oscilloscope. The dotted boxes indicate analog functions, the rest being digital.

If you only need an oscilloscope for occasional testing or repair work, then the under-\$2000 analog workhorse will do everything you need, and it's probably the best value for the price. However, if you do any amount of production, quality control testing or R&D work, the digital storage scope's remarkable features may be for you.

The analog scope reduced to its simplest form consists of an amplifier and a cathode ray tube; the signal on the input jacks is suitably amplified and applied directly to the screen — what you see is a representation of the signal at the input, in real time. What you can find out about the signal's parameters depends on the scope's features and how well you can interpret the screen display; generally, you can easily get approximate voltage readings or elapsed time per division or a reasonable figure for risetime. If the signal is very slow, such as a few seconds per cycle, the only way to see it is to invest in a storage CRT. This actually holds the display in the electronically refreshed phosphor; it can also be used to build up an image from multiple sweeps of a very fast signal.

Storage is Forever

The DSO, on the other hand, immediately converts the input signal (after suitable attenuation or amplification in the front end) to a digital bitstream. The sampled and converted signal can now be stored in digital memory for processing or later recall. It's this that allows the DSO to perform its magic: display and comparison of multiple waveforms, zooming, instant and accurate measurement of voltage, time, frequency, risetime and more. In addition, many functions that used to require complex rotary switches can now be automatically controlled by the scope's processor.

The front end of the DSO is much the same as its analog counterpart: 1:1 or 1:10 probes, a stepped attenuator, and the usual functions such as AC/DC/gnd switches. This is true whether the scope has regular rotary switches or automatic settings. It's also the point at which the signal-handling of the two types becomes completely different.

Sampling

The conversion of the signal to digital numbers and subsequent storage in memory has other advantages: since the signal is read out of memory rather than synchronizing it with an analog sweep voltage (typically 2% or 3% accuracy), the DSO timebase can be much more accurate (typically 0.1%). The signal can be recalled at any time without deterioration, allowing the user to compare

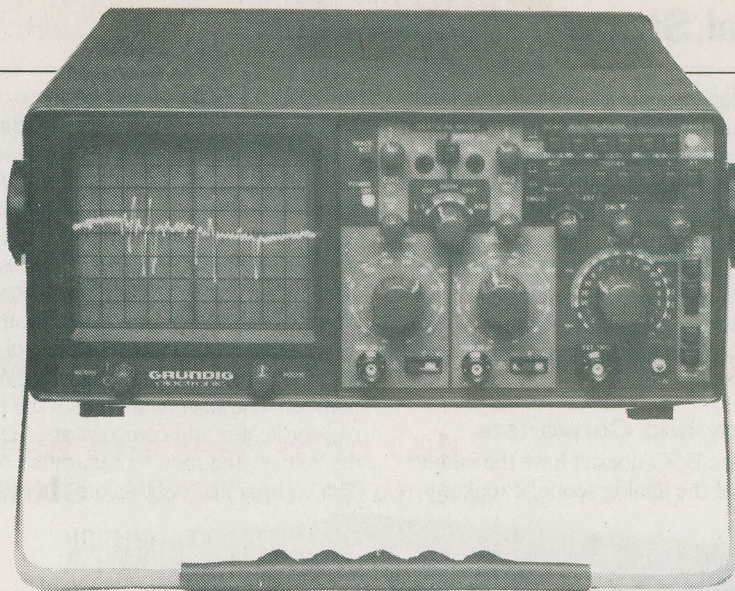
it with a new signal using the accurate measurement system that storage allows. Since proper conversion and storage is the heart of the DSO, here's a brief look at the methods of sampling.

In the same way as the digital tape recorder samples a number of instants in time and converts the audio voltage in each sample to a digital number, the DSO converts the input signal voltage samples to a code; however, the audio recorder is limited to a fixed frequency range, unlike the scope, which has to deal with anything and everything from DC to its maximum. For this reason, several methods are used to cope with very high speed signals, since a 50MHz signal would put quite a strain on the sam-

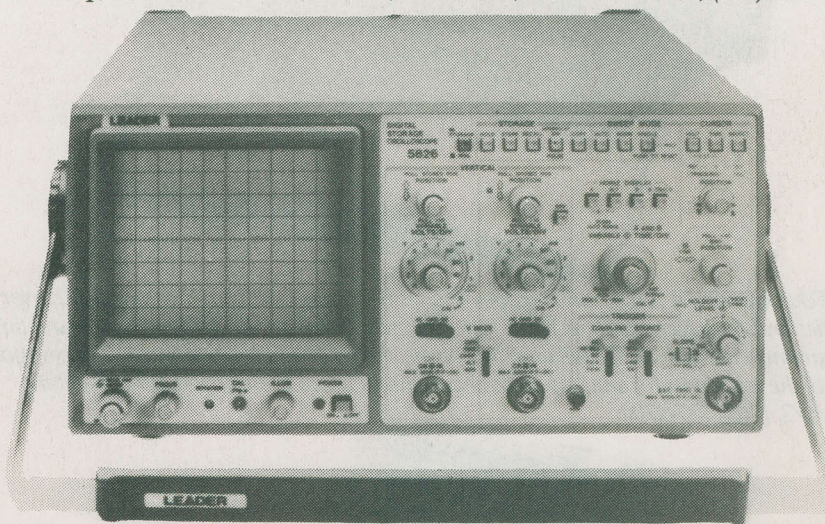
pling circuitry and memory capacity.

Realtime Sampling is used to sample low-frequency or one-time signals; the entire sweep is sampled as it happens and the data stored. The limitation is that the sample rate must be high compared with the incoming signal frequency (just as the digital audio player must sample at a much higher frequency than the audio — 44kHz is the usual rate).

Equivalent-Time Sampling is used when fast but repetitive signals must be converted. In this case, samples are taken during only part of a sweep; more are then taken on the following ones. The separate, stored images are then assembled to form a continuous time trace. Equivalent-time



The Grundig SO 20 DSO is a portable unit with 20MHz bandwidth, 1024 by 8-bit resolution in each channel, and roll or refreshed operation for display of slow signals. Tradeport Electronics Group, 1179 Finch Ave. W., UNit 24, Downsview, Ontario M3J 2G1, (416) 736-0866



The Leader Model 3060D is a 40MS/s DSO with a 60MHz bandwidth. It features cursor readouts of voltage, time, frequency, phase and voltage/time differences. Up to four waveforms can be stored in memory. Omnitrnix, 2410 Dunwin Dr., Mississauga, Ontario L5L 1J9, (416) 828-6221.

Digital Storage Oscilloscopes

sampling can be done sequentially, which is relatively uncomplicated to process but isn't good at showing the rising edge of short, widely-spaced pulses, and also by random sampling, in which single samples of the signal are taken at random points along the sweep. These samples are stored in a memory location referenced to the trigger point. The advantage is good displays of fast edges, pre- and post-triggering, and jitter-free displays.

Accuracy and Converters

Although the DSO doesn't have the infinite resolution of the analog scope, it makes up

for this with its much more extensive measuring power and flexibility. Since the vertical (voltage) levels of a signal must be represented as digital numbers, the higher the resolution, the longer the binary number required. 8-bit converters give 256 levels, an accuracy of 0.4%; a 10-bit increases this to 1024 or 0.1%. Generally, the 8-bit conversion is adequate for most applications.

There are two basic methods of actually converting the voltage sample to a digital number. The *flash* method uses the familiar resistor ladder and comparators; the higher the voltage, the more comparators turn on. The comparator outputs are decoded to a

binary number within the IC. This method is very fast, but accuracy is limited by the necessary precision of the resistor ladder. The second method, one used by the Philips 3350 on our first page, is the charge-coupled-device (CCD). It consists of a series of microminiature capacitors arranged to form an analog shift register. The signal can be fed into this register and clocked out again as slowly as required for digital conversion; CCDs can be multiplexed to increase the sample rate and memory depth. They provide high speed performance at a much lower cost than other methods.

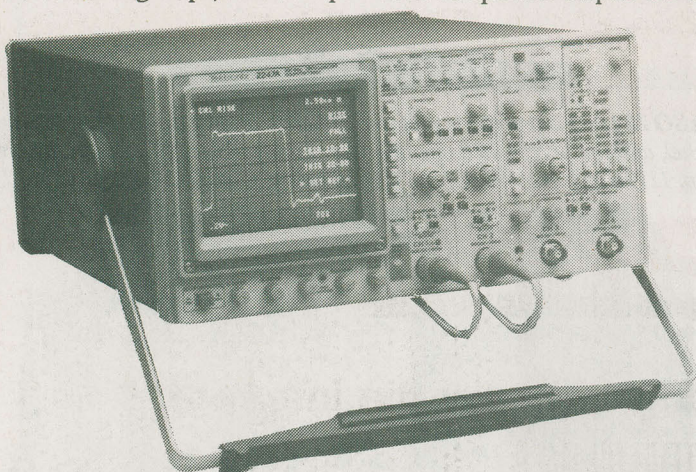
Software Switches

One of the most expensive sections of an analog scope is the precision rotary switches with their accurate resistors and capacitors. In the DSO, these can be replaced with software control of solid-state switches, an inexpensive and much more versatile method. We had a Philips 3350 in for review, and it serves as a state-of-the-art example of what you can do with front panels. It lists at \$6,461 at the time of writing.

You may notice from the photo that there isn't a rotary or toggle switch to be seen, only pushbuttons. Between the CRT face and the buttons is a backlit LCD panel that reads out the status of the various settings. Look for the beam-finder button — there isn't one. Instead, you press *Auto-Set*, and the scope sets itself to all the parameters required to display several cycles of the applied signal, regardless of its voltage or frequency. The processor can even tell what type of probes you're using (Fluke-made probes have an identifying resistor in the BNC). If you'd rather see a different display than the default, rocker buttons let you step through the ranges while the LCD keeps track. The myriad of other controls let you set the triggering, memory store, and the relation of the two channels (invert, A/B, etc.).

In general, I take a dim view of high-tech bells and whistles; they're often added as a sales gimmick rather than a real improvement over traditional methods. Rotary switches and toggles, for instance, let you know exactly what the settings are. However, the first time I tried the Philips 3350, I was hooked! Forget the switches — I want *Auto-Set*! It occurred to me that the switches aren't much good if you know what the settings are and still can't find the signal.

Look into DSOs — they're costly compared to analog, but they're a delight to use. Special thanks to David Green of Technology Marketing Concepts, who supplied us with much technical information from Fluke/Philips. ■



The Tektronix 2247A is a portable scope which is not a true DSO, but has complete cursor facilities and on-screen readouts for its four channels. There are 11 different voltage and time measurements as well as rise/fall time and numerous gated measurements for choosing portions of the waveform for analysis. Tektronix Canada Inc., PO Box 6500, Barrie, Ontario L4M 4V3, (705) 737-2700.



The Philips PM 3308 is a compact, portable DSO with a case somewhat like a laptop computer. The screen is an electroluminescent panel; bandwidth is 100MHz, and all controls are software types rather than switches. A wide range of analysis facilities make it suitable for laboratory measurements in the field. Fluke Electronics, 400 Britannia Rd. E., Unit 1, Mississauga, Ontario L4Z 1X9, (416) 890-7600.

The Techie's Guide to C Programming

Part 4

Meeting and getting to know the interrupt.

STEVE RIMMER

If the structure of C programs is a tad daunting when you first come upon it, the structure of the data they use is very nearly overpowering. Whereas just about everything under BASIC is handled with real numbers and occasional strings, C has a plethora of data types. Furthermore, if you don't find a data type you fancy after a casual browse through the manual you can easily add your own — C offers facilities to do this.

Now, you might well be thinking that this obsession with data is some sort of brain problem on the part of bald headed programmers in white lab coats, and nothing you should really be concerned about. To some extent this is true, at least for simple programming, but much of the power of C is in how it deals with data. Once again, we see in C an example of language efficiency at the expense of convenience. By forcing you to think about data types, rather than thinking about them for you, as in the case of BASIC, C creates faster, tighter programs.

It's not the fault of C that you haven't got sixteen fingers.

This month we're going to look at data and how it's handled under C.

chars, ints and floats

There are those who would have said that the best thing to do with an *int* if you happened across one would be to step on it and brush the remains under the television set. This is probably a wise move.

The basic unit of data under C — and, in fact, under any language running on a PC — is a byte. A byte is eight bits wide, and, as such, can represent numbers from zero to two hundred and fifty five. This is not a great range of numbers, and bytes all by themselves aren't much use, except for holding fixed range data like ASCII text.

Under C, a byte is called a *char*, for character... indicating its relationship with text.

The most usual data type found under C is *int*, for integer. We should qualify this a bit: it's actually a signed integer. This is a 16-bit number — two bytes — and can hold numbers from -32767 to 32768. We can also declare an *int* as being unsigned, which means that it can hold numbers in the range of zero through 65535.

We can move data between *ints* and *chars* freely so long as we're conscious of what we're doing. For example, if we have

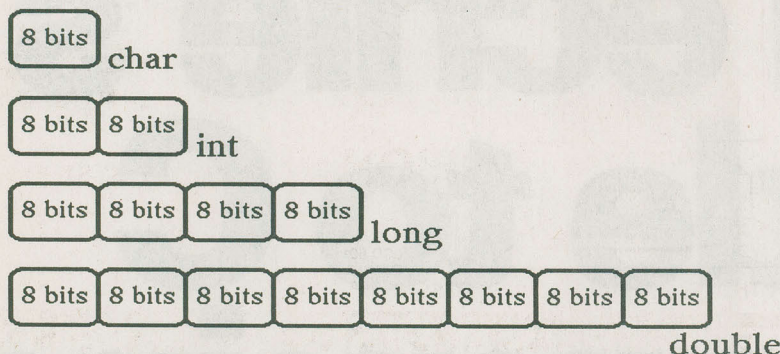
a *char* which contains the letter "A", which is the ASCII value of 65, and make an *int* equal to this, the value of the *int* will be 65. The lower of the two bytes comprising the *int* will be loaded with the value of the *char* and the upper byte will be loaded with zero.

If we have an *int* which holds the value of one thousand and we make a *char* equal to this, the value of the *char* will be two hundred and thirty two. This is a bit of a head scratcher; the two numbers don't really seem to have a lot to do with each other. Actually, they do, but only to a computer.

If you could look at the aforementioned *int* as the computer does, you'd see that it consists of the value three stored in its upper byte and two hundred and thirty two stored in its lower byte. When we try to store it in a *char*, the upper byte gets thrown away.

Moving data between variables of differing types is called "casting". Moving data between *ints* and *chars* is the only case in which C allows us to cast data freely without explicitly telling it what we're up to. Here's a more formal example of casting.

The Teachie's Guide to C Programming



Numeric data types under C.

When 16-bits just aren't enough, and this happens quite frequently when you're dealing with large numbers, C offers another data type called *long*, for long integer. This is a 32-bit number, with your choice of signed or unsigned operation. The unsigned version can hold numbers up to 4,294,967,295, or roughly the number of shoes that Mila Mulroony buys in an average afternoon's shopping.

If you cast an *int* to a *long* just by making one equal to the other, C is not obliged to fill the upper part of the *long* with zeros, so the actual value of the *long* may be undefined. The proper syntax to make sure that the *long* represents the same thing as the *int* is this:

```
int i;  
long l;
```

```
l = (long)i;
```

There are several more complex situations wherein this becomes still more important. For example, consider that we have two *int*s, called *m* and *n*, and that they each hold sort of large numbers, such that if they're multiplied together the result will require a *long* to hold it. This expression

```
long l;  
int m,n;
```

```
l = (long)m * n;
```

will avail of us of an erroneous result. The two *ints* will be multiplied together as 16-bit numbers, they'll overflow and the resulting 16-bit mistake will be cast to a *long*. What we really wanted to say was this.

```
l = (long)m * (long)n;
```

Up until now, all the numbers we've dealt with have been integers of one sort or another. C also has floating point variables, and the performance of the floating point packages of various C compilers is the subject of much contention and benchmarking. Floating point variables are of the types *float* or *double*, depending on their precision. In fact, on most PC compiler packages, all floating point numbers are treated as *doubles*. A *double* is a 64-bit number.

You can cast between integers and floating point numbers with the same syntax as you would between *ints* and *longs*, although you should be aware that when you do C is installing some fairly elaborate code to translate between its floating point representation and straight machine level integers.

If you've done any BASIC programming you might well look at all this and wonder why anyone would want to pound his or her head against such a hard, poorly mortared wall, juggling all these variable types, when you can just let a language like BASIC take care of them for you. The reason is fairly simple. Under BASIC, variables default to floating point, with integer numbers optional. Floating point numbers are hundreds of times slower to work with than are integers. Long integers are slower than short, 16-bit, ones, and short integers are correspondingly slower than are *chars*.

If you let the language choose your variables for you, it will have to choose the ones which can handle the most complex numbers possible, as it cannot know the use to which you intend to put the numbers. You, hopefully, can figure this out in advance, and in forcing you to choose the precise data type for every variable in your program, C allows you to optimize things

in a way that it cannot. This contributes greatly to the ultimate speed and size of your final program.

Pointers from Hell

So far, all we've looked at have been simple numbers. Anyone can cope with numbers. Under C, however, we also have pointers. Pointers are dreadful, horrible, ugly, repulsive, demonic things which will crawl into your head and wrap their slime encrusted tails about your brain, muttering insanely into your ear until you go mad. No foolin'.

Regrettably, you can't really get into C without them.

Under C, there is no data type which can hold strings. Instead, C forces us to treat strings as what they really are, that is, a collection of bytes. Hence, a string under C is defined as an array of *chars*.

This is how we define a string.

```
char s[65];
```

Having done this, the variable *s* is a sixty five byte string. Under C, all strings are terminated by a zero, so for practical purposes, we must be sure not to try to store more than sixty four bytes of text in this string, to leave room for the null at the end.

Here's a typical application of this string.

```
strcpy(s,"Wombats in love");
```

This will copy the second string into the first. We are passing two strings to the function *strcpy*... almost.

When we pass integers to a function, we really pass the actual numbers. The mechanism for doing this is to push the numbers up on the stack, call the function and then pop them back off the stack again. The function peeks at the stack to find the numbers it was passed. Don't worry if you aren't really into stacks just yet — the internal workings are not all that important just yet.

The meaningful bit to consider, though, is that to pass a sixty five byte string in the same way as we'd pass an integer, we'd have to save an awful lot of data somewhere before we called the function it's being passed to. This would be very, very inefficient, and C won't let you do it just on principal. As such, when we talk about passing a string, what we really mean is that we pass a pointer to a string.

A pointer is simply a number which represents the location in memory where a

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The Techie's Guide to C Programming

thing lives, as opposed to the thing itself. If the string "Wombats in love" lived at location one thousand, then we would, in effect, be passing the number one thousand as a pointer to it. A function which expects a pointer to something will know to look at where the pointer points to get at whatever it is being passed.

Since strings are *always* passed around as pointers, it's quite painless to deal with them as such. Wait a sec... we'll get into pointers to other things shortly.

If *p* is a pointer to the string "Wombats in love", then *p[0]* will be a char of the value eighty seven... the ASCII value for "W". If you recall our discussion of this notation a few months back, the value of **p* will also be 87 — the two representations are equivalent in this case.

The important thing to note about passing values versus passing pointers is this. If you pass an *int* to a function and the function changes it, it will not affect the value of the *int* in the function which called the function that did the changing. When you pass a variable to a function, you are passing a copy of that variable. If you pass a pointer to a variable, however, the called function has access to the actual number in the calling function, and it can affect the value of it.

As such, consider this function.

```
strupr(s)
char *s;
{
    int i;j;

    i = strlen(s);
    for(j=0;j++<i) s[j]=toupper(s[j]);
}
```

This bit of C code will translate any string passed to it into all upper case. The function it calls, *toupper*, is a library function which returns the upper case version of any alphabetic character passed to it. The important part to observe about this function, however, is that it doesn't *return* an upper case string; it changes the actual string passed to it.

Now, to finish things off, we're going to look at a slightly more obtuse bit of pointer notation... pointers to *ints*.

Writing a function to exchange the values of two integers is a classic C language problem. Here's how it *isn't* done.

```
swap(i,j)
int i,j;
{
    int t;
```

```
t = i;
i = j;
j = t;
}
```

This doesn't work because the *i* and *j* that this function gets to work with are *copies* if the *i* and *j* in the function which calls it, and those copies get thrown away when this function is finished. This is the correct function

```
swap(i,j)
int *i,*j;
{
    int t;
```

```
t = *i;
*i = *j;
*j = t;
}
```

We must call this a bit differently too.

```
int i,j;

swap (&i,&j);
```

The *&* operator tells C to pass the address of the thing it's in front of, rather than the thing itself. Declaring *i* and *j* as being pointers to *ints* rather than the *ints* themselves in the *swap* function allows us to deal with the actual contents of the numbers. Just as we said that the notation **p* got at the first byte in our string, above, so too does **i* get at the value of the integer pointed to by *i*.

Pointing out

If this all seems a bit obtuse, don't let it bother you too much at this stage. Because it forces you to deal with the real world in its handling of data, C makes very clever use of its numbers but it also requires that you think a lot more about what you *really* want to do.

Data type errors are amongst the most common problems in writing C programs, and, as such, the latest generation of compilers are very good at spotting them. If you try to do anything untoward the compiler probably will help you avert it. This is extremely useful while you're getting your mind around just how all this peculiar notation goes together.

Next month we're going to look at complex data. You probably thought that all this was quite complex enough. Wait 'til you find out about *structs* — they make pointers look almost civilized. ■

numbers to the port will cause different combinations of lights to come on by design.

The important thing here, however, is that the lights don't know what's good data, and they're quite content with the garbage data left over from the PC's powering up. If all you're after is a light show, this probably won't matter. On the other hand, if all you're after is a light show you could probably think of an easier way to get it than by tying up a computer.

What we need is a way to signal our hypothetical peripheral when the data at the port is good. We need a flag.

The simplest flag is simply one bit of our port. For example, consider changing the relay situation around such that there are now only seven lights. The relay for the highest bit of the port is connected between ground and the common side of all the light bulbs. Now, in order to light the bulbs the seventh bit of the port has to be set. The seventh bit of the port has become our flag. When it's high, the light bulb peripheral knows that the data at the port is good.

This has one serious drawback. We've been forced to give up a light bulb to get our flag.

Since we're just oozing with available port addresses, it would be a lot more practical to go back to our eight original light bulbs and use a second port to handle the flag. The light bulb port is called the "data" port, and the flag port the "status" port. We would now need a second set of 74LS77 data latches on our card, one for each port. We could connect the common relay to the lowest line of the status port, such that if it went high the light bulbs would be free to light based on the data at the data port. If it went low, they would all be inhibited no matter what appeared at the data port.

In more complex applications, such as interfacing to slow data peripherals, the role of the status port becomes more involved. Consider a printer, for example. We know that in the time it takes the printer to print a single character, the computer could have sent a few thousand to the port address of our choosing. Obviously, we would want a status flag to tell

the printer that there's data a'waitin', but we would also need a flag to tell the computer that the printer is free to accept data, lest it send a new byte to our latch before the printer has had a chance to read the previous one. This requires some still more complex hardware, as our latch must be bi-directional.

We'll look at the details of this in a future installment.

Byte Size pieces

Having reached the point wherein there is actual, useable, information appearing at the output of your PC, you might want to start thinking about things you'd like to interface to. There's still quite a bit to look at before we have a complete, practical two way data path between the reality of the universe and the decided unreality of a computer, but things are looking more and more like we'll get there in the end.

There's a light at the end of the tunnel... with any luck, it won't turn out to be someone with a particularly bright monitor playing video games. ■

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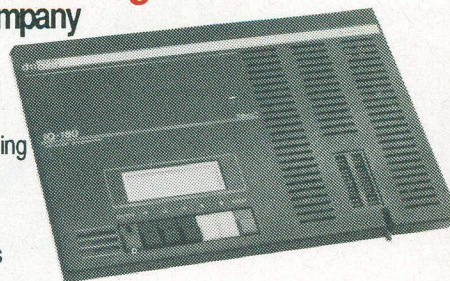


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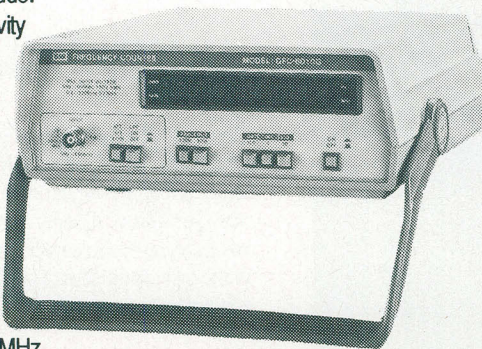
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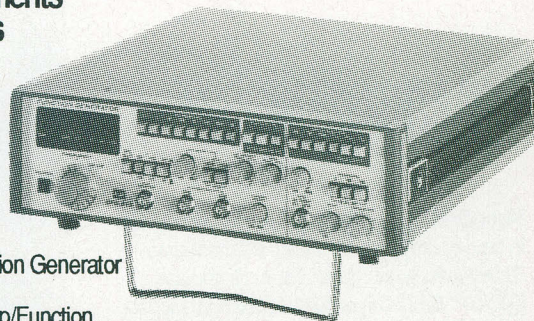
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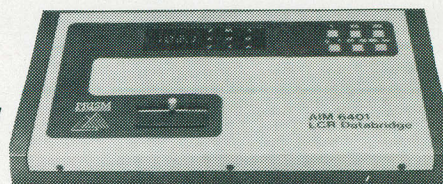
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